BULLETIN

OF THE

Society for the Promotion of Engineering Education

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EDITORIALS.

The Princeton Meeting.—The only important change in the Princeton meeting plans since the last announcement has been the changing of the dates of the meeting to the last week of June. The days will be Tuesday, June 23, to Friday, June 26. This change has been made to avoid conflict with the convention dates of the American Society for Testing Materials. While unfortunately other conflicts result, it is the old case of "out of the frying pan into the fire" as the officers have found each year in trying to find meeting dates which would suit the convenience of all. The reason for avoiding conflict with this particular society is that it draws its members from all branches of the engineering profession as does the Society for the Promotion of Engineering Education. The members who attend one convention are very likely to be those who would like to attend the other for the reason that teachers take an active part in the development of testing as it is closely allied with their work. Returning to the subject of the meeting it may be said that excellent progress is being made in the rounding out of the program and that only a half dozen papers will be presented. The larger portion of the time has been allotted to the discussion of committee reports. The present plan is to have the committees take charge of the meetings while their respective reports are being considered, the members of each committee occupying the platform for the time being. By this plan it is expected that interest will be focused upon each report in turn and that it will have the hearing which it deserves.

For the purpose of whetting our appetite for the Princeton meeting a number of short articles have been secured to show the several phases of life on the Princeton campus. In February we had Dean West's account of the graduate college and this month Mr. Close gives an outline of the lay-out of the campus itself and a helpful map accompanies his article.

Developing Local S. P. E. E. Interest.—One of the problems of any society is the keeping up of interest between meetings and the consequent steady progress of the matters to which the society devotes its attention. This previous lack is now being met in many of the national societies through sectional organizations. Such a plan has been proposed for the Society for the Promotion of Engineering Education but it has not seemed to be practicable in view of the nature of the society's activities. A plan which is entirely practicable, however, is one mentioned elsewhere in this issue which has been tried in Cleveland. President Howe, of the Case School of Applied Science, invited the members of his faculty, all of whom are very loyal to the society, to his residence for an evening of good-fellowship and discussion of topics presented at the Minneapolis meeting. He included in the invitation other local members. This plan secures all of the advantages of local sections and has the advantage of not increasing the amount of machinery already burdensome enough. The subjects which are brought up at the annual meetings of the society and through contributions to the BULLETIN warrant more attention than can be given to them at conventions. Some kind of local gathering seems necessary. It is to be hoped that President Howe's example will be followed generally.

Academic Efficiency.—Professor Passano brings before us for attention the subject broached in Director Person's Minneapolis paper having the above title. Professor Passano takes the position that it is not practicable to functionalize educational processes as manufacturing processes have been treated with such good effect. He makes the interesting point that the application of the principles of scientific management to education does not include the provision of a bonus for the teacher. The discussion of this topic brings forcibly to mind the fact that, after all, education does not consist of a certain number of processes but is largely a matter of personality. Director Person's plan was designed to make the necessary

mechanical part of the process efficient and inconspicuous so that the personality of the teacher might have its most powerful effect. Professor Passano fears that the effect of too much mechanism will be to dwarf the personality of the teacher. Which is right we are not prepared to say, but this much is beyond dispute. A strong personality will produce a beneficial influence with or without system, while the best system will fail without personality behind it. No advocate of any system would contend otherwise.

Educational Value of Student Societies.—One of the greatest criticisms of technical graduates is based on their lack of ability to adjust themselves to industrial conditions. In the schools attention is necessarily concentrated on design and the underlying principles. Now this is all well enough as far as it goes does not go far enough. Engineering consists very little of things and their laws but very much of men and their ways. A knowledge of the latter cannot be taught in formal courses of instruction but it must be had somehow. Just here is where the engineering society can help out. In the wide world of engineering the technical society plays a most important part and the leaders in the one are prominent in the other. The student society reflects the spirit of the big outside world especially if the organization is a part of a national society. In the pages of the BULLETIN the reader will notice a tendency to give more and more attention to this phase of educational work. Teachers of technical subjects should encourage their students to take an active part in the work of these societies as nothing will tend more directly to bring them into touch with their future work.

Arousing Interest in Timely Topics.—One of the greatest encouragements to the publication committee in connection with the BULLETIN is the increasing use of its columns by the membership for the purpose of discussion. If one will examine the pages of this number, for example, with a view to discovering how much of the space is occupied with spontaneous contributions and how much with discussion of topics

previously suggested in papers or articles he will find that the latter is greatly in excess of the other. There are after all very few independent educational topics, just as there are few fundamental jokes which form the basis of the so-called witticisms of our comic papers. The educational processes go on from age to age, with each element coming up for special study from time to time. Just now we are struggling with the teaching of fundamental subjects which for some reason seem more difficult to teach now than ever before. It is quite possible that such matters as these are prominent because we have better facilities for discussion than our fathers did. Some educators think that we talk too much about teaching processes and that the effect is bad in its effects like excessive personal introspection. On the whole, however, we believe that it is beneficial to keep the unsolved problems before us. Even if we cannot solve them all at once or soon each contribution helps toward the ultimate solution. The members of the society are therefore urged to bring to our attention from time to time such subjects as they find pressing upon them in their own work.

The editor calls attention to two matters regarding the Committee on Coöperation with Secondary Schools of which Prof. H. E. Webb is chairman and of which Profs. L. F. Rondinella and H. T. Clifton are members. In the first place the name of Prof. Clifton was incorrectly given as that of the chairman, in the February BULLETIN. In the March issue the committee was not mentioned in the list of special committees.

COUNCIL ACTIONS.

By letter ballot, dated February 9, the Council elected the following to membership: (*Individuals*) Messrs. H. P. Boardman, A. I. Brown, (Mrs.) K. D. Brown, W. H. Clapp, J. R. Cockburn, J. S. Eaton, R. D. George, K. E. Guthe, W. R. Ham, F. E. Haskell, S. J. Hoexter, L. R. Leonard, Wm. T. Lyle, R. S. Naidu, G. G. Pond, S. R. Pritchard, F. W. Roys

and C. S. Sperry. (*Institutions*) University of Missouri, The Pennsylvania State College, University of Pennsylvania, Princeton University, University of South Carolina, Tufts College and The University of Wisconsin. See pages 18 and 19 of the February BULLETIN. The following applications, received after the February BULLETIN went to press, were also acted upon favorably:

BIRD, H. C., Assistant Professor of Engineering, Pennsylvania Military College, Chester, Pa 1914
BOGART, FRANK, Superintendent of the Mechanic Arts Course, Louisiana Industrial Institute, Ruston, La. 1914
BRAUNE, G. M., Assistant Professor in Civil Engineering, University of Cincinnati, Cincinnati, O. 1914
GATES, A. O., Instructor in Machine Design, Purdue University, W. Lafayette, Ind. 1914
HOOD, G. J., Associate Professor of Mechanical Drawing, University of Kansas, Lawrence, Kans. 1914
MACLIN, EDW. S., Instructor in Mechanical Drawing and Descriptive Geometry, The University of Wisconsin, Madison, Wis. 1914
ROOD, J. T., Professor in charge of the Department of Electrical Engineering, Lafayette College, Easton, Pa. 1914
TALLMAN, WM. D., Professor of Mathematics, Montana State College of A. & M. Arts, Bozeman, Mont. 1914
THURBER, C. H., Editor, Ginn & Co., 29 Beacon St., Boston, Mass. 1914
WALKER, AMASA, Manager of Educational Dept., Longmans, Green, & Co., 443–449 Fourth Ave., New York, N. Y. 1914
WATSON, H. L., Instructor in Machine Design, Purdue University, Lafayette, Ind. 1914
WHEATLEY, G. S., Instructor in Mechanical Engineering, University of Pennsylvania, Philadelphia, Pa. 1914

By letter ballot, dated April 1, the Council elected the following to membership:

INDIVIDUALS.

(Applications received to March 14th only.)

ALBERT, C. E., Instructor in Mechanics and Materials of Construction, The Pennsylvania State College, State College, Pa. 1914
BACHE-WIIG, JENS, Professor of Electrical Engineering, Norwegian Technical University, Trondhjem, Norway, Europe 1914
BREHMER, W. G. H., Instructor in Mechanical Engineering, University of Pennsylvania, Philadelphia, Pa. 1914

NEW MEMBERS.

BUYERS, D. E., Instructor in Mechanical Engineering, Oregon Agricultural College, Corvallis, Ore. 1914

CALLAGHAN, R. T., Professor of Civil Engineering, Christian Brothers College, St. Louis, Mo. 1914

DENN, H. H., Instructor in Mechanical Drawing, Drexel Institute, Philadelphia, Pa. 1914

HARRIS, C. L., Instructor in Drawing and Descriptive Geometry, The Pennsylvania State College, State College, Pa. 1914

HESSE, G. E., Assistant Professor of English, Iowa State College, Ames, Ia. 1914

HUELLE, H. R., Mechanical Designer, care of Trent Engineering Co., 227 Lake St., Reno, Nevada 1914

HUND, AUGUST, Research Engineer, Research Laboratory of General Electric Co., Schenectady, N. Y. 1914

HUNTINGTON, W. C., Assistant Professor of Civil Engineering, University of Colorado, Boulder, Colo. 1914

JAMES, R. L., Assistant Professor of Engineering Drawing, University of North Carolina, Chapel Hill, N. C. 1914

JONES, G. R., Professor of Sanitary Engineering, University of Kansas, Lawrence, Kans. 1914

MCGOWAN, JOHN, Associate Professor of Applied Mechanics, University of Toronto, Toronto, Ont., Canada 1914

MACKAY, H. M., Professor of Civil Engineering, McGill University, Montreal, Quebec, Canada 1914

MANN, C. R., Associate Professor of Physics, University of Chicago, Chicago, Ill. 1914

MUNRO, M. S., Assistant Professor of Electrical Engineering, Tufts College, Tufts College, Mass. 1914

PATTERSON, T. S., Instructor in Mechanics and Materials of Construction, Pennsylvania State College, State College, Pa. 1914

ROARK, LOUIS, Instructor in Geology, Mississippi A. & M. College, Agricultural College, Miss. 1914

SCOATES, DANIELS, Professor of Agricultural Engineering, Mississippi A. & M. College, Agricultural College, Miss. 1914

SCRUGHAM, J. G., Professor of Mechanical and Electrical Engineering, University of Nevada, Reno, Nev. 1914

SHATTUCK, E. L., Professor of Applied Mechanics and Thermodynamics, Louisiana Industrial Institute, Ruston, La. 1914

STOCKWELL, F. C., Instructor in Electrical Engineering, Stevens Institute of Technology, Hoboken, N. J. 1914

SURVEYER, ARTHUR, Consulting Engineer, Surveyer & Fregon, 56 Beaver Hall Hill, Montreal, P. Q., Canada 1914

WEBER, JOHN, Assistant Professor of Mechanical Engineering, University of Pittsburgh, Pittsburgh, Pa. 1914

WILD, H. J., Professor of Engineering, Pennsylvania Military College, Chester, Pa. 1914
WINSLOW, A. E., Professor of Civil Engineering, Norwich University, Northfield, Vt. 1914

INSTITUTIONS.

ALABAMA POLYTECHNIC INSTITUTE, Auburn, Ala., Chas. C. Thach, President 1914
UNIVERSITY OF ARIZONA, Tucson, Ariz., Arthur H. Wilde, President 1914
BROWN UNIVERSITY, Providence, R. I., W. H. P. Faunce, President 1914
THE CITADEL, THE MILITARY COLLEGE OF SOUTH CAROLINA, Charleston, S. C., Col. O. J. Bond, Supt. 1914
LEHIGH UNIVERSITY, South Bethlehem, Pa., Henry S. Drinker, President 1914
RUTGERS COLLEGE, New Brunswick, N. J., W. H. S. Demarest, President 1914
THE TEMPLE UNIVERSITY, Philadelphia, Pa., R. H. Conwell, President 1914
THE THAYER SCHOOL OF CIVIL ENGINEERING OF DARTMOUTH COLLEGE, Hanover, N. H., Robt. Fletcher, Director 1914
UNIVERSITY OF UTAH, Salt Lake City, Utah, J. T. Kingsbury, President 1914
WASHINGTON UNIVERSITY, St. Louis, Mo., David F. Houston, Chancellor 1914

LETTERS TO THE EDITOR.

FACULTY SCIENCE CLUB.

SECRETARY, S. P. E. E.,

Dear Sir: Replying to your note of recent date regarding the Nevada Faculty Science Club. This is an organization of faculty members interested in scientific research and development, who meet once a week to discuss various subjects presented for consideration. It serves as a medium of publicity for the work of the members.

Yours truly,

J. G. SCRUGHAM.

RENO, NEV.

P. S. I enclose application for membership in the Society.

Laboratory Title Sheets.

Secretary S. P. E. E.:

Permit me to make a correction in the note on page 30 of the February Bulletin referring to our laboratory title sheets. They are used not only by the electrical engineering department, but by all departments in the college of engineering, the purpose being to secure some degree of uniformity between the departments, as well as within them, separately.

Yours very truly,

Gustav Wittig.

University P. O., Ala.

BOOK REVIEWS.

Modern Seismology. By G. W. Walker, A.R.C.Sc., M.A., F.R.S., formerly Fellow of Trinity College, Cambridge. Longmans, Green and Co., New York, 1913. 6 by 9 inches, xii + 88 pp., $1.40 net.

This small book is an excellent and up-to-date introduction to seismology written from the point of view of a trained physicist, experienced in seismology. It is intended for readers with good mathematical and physical training. The book includes a good statement of the dynamical theory of seismographs; descriptions of the three principal types of seismographs now in use; two chapters on the installation of seismographs and the determination of their instrumental constants; three chapters on the theory of the propagation of earthquake waves through the solid earth and the interpretation of seismograms which follow therefrom, and one chapter on earth tremors, minute vibrations in the earth not due to earthquakes.

To the reviewer the most interesting parts of the book were those indicating how it is known that the vibration in the wave which first reaches an observing station from a distant earthquake is longitudinal with respect to the direction of progress of the wave and that the transverse waves arrive on a slower

schedule later, how by use of this knowledge the distant earthquake center may be located, and how from the seismograms some information may be secured in regard to the density and modulus of elasticity of the material which lies far beneath the surface of the earth.

JOHN F. HAYFORD.

Photo-electricity, the Liberation of Electrons by Light; with chapters on Fluorescence and Phosphoresence, and Photo-Chemical Actions and Photography. By H. STANLEY ALLEN, M.A., D.Sc., Senior Lecturer in Physics at University of London, King's College. Pp. 221. Longmans, Green and Company. $2.10 net.

As its name implies, "photo-electricity" is a complex subject of great importance, for it is concerned with the electrical effects produced by the action of radiation and thus involves the constitution of the atom and the character of radiation itself. It is a field in which a large amount of work has been done but yet one which will prove of unlimited fruitfulness to investigators of the future. Within the past few years great strides have been made, especially by experiments in a high vacuum. Even so, experiments have not yet been made upon metals entirely free from gases.

This book by Dr. H. S. Allen is very valuable in that it collects in good form the important results of the numerous investigations which have appeared up to and including a part of the year 1913. It is the only work of its kind in the English language and, indeed, it is the only book in any language which includes an account of the valuable work done within the past four years. The word "photo-electricity" is here used in its usually restricted sense, *i. e.*, "to denote a change in the state of electrification of a body produced by the action of light." The greater portion of the book, 180 pages, is devoted to a discussion of cases where a change in electrification is readily observed; but the last 60 pages contain an account of fluorescence, phosphorescence, photo-chemical actions and photography. These subjects are not presented in detail,

but only from the point-of-view of photo-electric action. The author extends Joly's view of the nature of the latent photographic image and gives an interesting explanation of photographic reversal.

The author has evidently covered the ground very thoroughly. He has given the reader the evidence, and, if the conclusions to be drawn from the evidence given in a chapter are not clear, the author's opinion is added. As everyone knows, omissions of most recent work are the most likely to occur. This doubtless explains the failure of the author to refer to Dember's contribution (*Phys. Zeitschr.*, 1912) on the ionization produced in the atmosphere. The book is primarily a reference work. It can be read with understanding by anyone having a knowledge of the elements of modern physics. As already intimated, it is a valuable monograph.

G. W. STEWART.

The Calculus. By E. W. DAVIS, assisted by W. C. BRENKE, edited by E. R. HEDRIK. The Macmillan Company, New York, 1912.

A series of mathematical text-books is in course of publication under the editorship of Professor Hedrik. His sound scholarship and vital interest in teaching is a guarantee of the practical and yet logical character of the series. The early chapters of the present work deal with the differentiation of algebraical functions only. They are remarkable for the large number of applications to geometry and kinematics and the clear explanations of the notions of a derivative and a differential. Integration is next introduced first as an antiderivative for both definite and indefinite integrals then found approximately as a summation and finally as the limit of a summation. The treatment here is most satisfactory although the whole book impresses one as coming hot from the class-room. The derivative of a logarithm is now found in a simple manner. First, for base *10* the derivative is made to depend on the intuitive idea that if $log_{10} x$ is plotted from the tables the graph has a definite slope nearly .434 at the $(1, 0)$. The base e is

then defined so that the slope of $y = log_e x$ at $(1, 0)$ is 1. The only possible improvement on this method is to first find the derivative of the exponential function since this is what is really found by the method. In the chapter on formal integration the treatment of rational fractions is elegant and logical. The limit of error after n-terms of the expansion of a function of x in powers of $x - a$ is found very simply by successive integration of the nth derivative of the function. In addition to the usual applications of the calculus to geometry and mechanics the book contains considerable geometry of space and the solutions of the common differential equations, also methods of determining empirical curves and a list of formulas and tables with numerous graphs of curves. In the opinion of the receiver this is at present the best elementary text-book of Calculus in the English language, particularly for colleges in which a full year's course is given. The explanations are lucid and the pitfalls so carefully pointed out that a bright student might almost dispense with an instructor.

F. R. SHARPE.

International Association for Testing Materials—Proceedings of the Sixth Congress, New York, 1912. Issued by the Association, Vienna, Austria. Two volumes of about 1,000 6×9 pages.

Proceedings of the American Society for Testing Materials—Sixteenth Annual Meeting, Vol. XIII, 1913. Published by the Society, Philadelphia, Pa. 1,141 6×9 pages.

The chief value of the two volumes of Proceedings of the International Association for Testing Materials is that of a work of reference for those engaged in the field of materials testing. The work of the Sixth Congress of the Association was divided into three principal sections. Section A considered problems of metals, and some of the principal subjects discussed in the papers of that section are: recent applications of metallography, hardness testing, heat treatment of metals, impact tests and endurance tests, and a discussion of the de-

The proceedings of Section B comprise papers on reinforced concrete, strength and soundness of cement, effect of sea-water and of electrolysis on concrete and masonry. In Section C miscellaneous materials are considered, including oils, rubber, wood, bitumen and other road materials, and there are descriptions of tests of fire-resisting materials, together with some general discussions on internal stresses in materials.

For the American edition of these Proceedings, the American Society for Testing Materials has prepared very complete subject and author indexes which facilitate reference to any desired paper or subject, and add very materially to the value of the volumes.

The annual volumes of the Proceedings of the American Society for Testing Materials have become the standard record of national progress in the study of the properties of the materials used in manufacturing and building. The 1913 volume is the largest yet published by the society, and largely owing to the excellent work of a committee on papers presented, the quality of the papers is unusually good. The American Society for Testing Materials devotes considerable time to the discussion and formulation of standard specifications for materials, and issues, in addition to its Proceedings, an annual year-book of standard specifications. The 1913 volume of Proceedings gives considerable space to discussion of proposed changes in specifications for materials, there are a number of papers describing improved testing methods and apparatus. Problems in the heat treatment of steel are considered, an interesting series of tests on the resistance of various grades of steel to wear is described, new tests for cement are proposed which shorten greatly the time required for testing, water-proofing of cement comes in for its share of attention, and a test to destruction on a full-sized highway bridge of reinforced concrete is described.

A carefully prepared subject and author index adds materially to the value of the volume as a work of reference, and sirability of international specifications for iron and steel.

its general appearance maintains the high typographical standards of the Society. H. F. MOORE.

Rays of Positive Electricity and Their Application to Chemical Analyses. By SIR J. J. THOMSON, O.M., F.R.S., Cavendish Professor of Experimental Physics, Cambridge; Professor of Natural Philosophy at the Royal Institution, London. Longmans, Green and Co., London, 1913. Pp. 129. Price $1.40 net.

This book has three important characteristics. It has been prepared by the leading authority in this field, it is written in clear style, and it contains material nowhere else appearing in a single volume. The work is valuable for two reasons. Here are presented in connected form, with the latest conclusions, the important results of the various contributions on positive rays reported from the Cavendish Laboratory during the past seven years, and made chiefly by the author himself. The volume may also be considered a book of information and directions for those who desire to apply the positive ray method in chemical analyses. For either one of these purposes the publication is amply justified.

The book asks of its readers only an elementary knowledge of the present theory of electric conduction in gases. The mathematical treatment is simple and very brief. Aside from four pages involving the calculus, the discussion is non-mathematical. This is due to the nature of the subject as well as the effort of the author to induce those interested in chemical analysis to apply the positive ray method.

The advantages of the use of positive rays in chemical analysis are presented in detail. They are briefly as follows: The method is more sensitive than spectrum analysis. For example, the helium in one cubic centimeter of air can be detected with ease. Indeed, the magnitude of smallest detectable amount of helium is not known. The method not only permits the detection of the presence of gases but simultaneously of the atomic weights. It further indicates whether the molecule is monatomic or diatomic. It is convenient, for a single photo-

graph reveals all the gases of the sample analyzed. It leads to the detection of systems which do not exist in the free state, and those which have but a transitory existence.

The monograph closes with a description of the experiments on an unknown gas which the author believes to be tri-atomic hydrogen, and on the evolution of helium and neon by the bombardment of cathode rays. These experiments are of great interest and raise questions of fundamental importance. They show very clearly the great value of the experiments on positive rays at the Cavendish Laboratory.

In addition to the subject-matter already indicated, the text presents a short account of the researches of Stark and others on the Döppler effect in positive rays, and of Gehrcke and Reichenheim on anode rays.

The book strongly reflects the admirable open-minded non-dogmatic mental processes of the author, an exhibit too seldom encountered where it ought always to exist, viz., in scientific contributions. G. W. STEWART.

OTHER SOCIETIES.

On January 17, 1914, the Spokane sections of the three great national engineering societies, the A. S. C. E., the A. I. E. E. and the A. I. M. E., held a joint meeting at the University of Idaho. The proposal of the Spokane engineers to hold this meeting was made in order to show their interest in engineering education and was intended to draw into closer relation the practicing engineers of this region and the faculties and students in engineering in the University of Idaho and Washington State College, who were expected to be present. A special electric train brought 62 engineers from Spokane, 94 miles away, and about the same number of the engineering faculty and students of Washington State College came from Pullman.

An hour was spent visiting the engineering laboratories and

drafting rooms. The afternoon meeting was held in the University auditorium. Mr. J. C. Ralston, consulting engineer, Spokane, read a paper on "Specifications for an Estimate for a Hydro-electric Plant and Lighting System for a City of 125,000 Population." A lively discussion followed in which the following took part: Mr. C. S. MacCalla, manager Washington Water Power Co., Spokane; Mr. Morton McCartney, city engineer, Spokane; Professor O. L. Waller, Washington State College; Mr. J. E. Moody, engineer Hurley-Mason Co., Spokane, and Professor L. J. Corbett, University of Idaho. The second paper, "Surface Tension System of the Flotation Concentration for Heavy Sulphide Ores," was presented by Mr. F. A. Ross, mining engineer, Spokane. This paper was discussed by Professor H. R. Robbins, of Washington State College, Mr. Richard Marsh, of Republic, and Professor F. A. Thompson, Washington State College. By request Professor R. S. McCaffery of the University of Idaho, made a short statement of his research work on the electrical reduction of zinc-lead ores.

An informal dinner at Ridenbaugh Hall was given by the members of the engineering faculty, University of Idaho, to the visiting engineers and to the engineering members of Washington State College faculty. This was in charge of Miss French, Dean of Women, and was a pronounced success. Notable features were: novel menu cards in the form of flow sheets, excellent singing by a student quartet and a student soloist and the deft service by young women of the university. Dean C. N. Little acted as toastmaster. The guests were welcomed by Acting President W. L. Carlyle and other toasts were responded to by Professor Waller for Washington State College, and Mr. MacCalla for the Spokane engineers. At 7:45 the party returned to the University auditorium where Mr. J. B. Fisken read a paper on "The Location of the Little Falls Tie-Line." On account of the early departure of the train for Spokane no discussion was possible.

C. N. LITTLE.

Early in February a joint meeting of the Philadelphia sections of the American Society of Mechanical Engineers and the American Institute of Electrical Engineers was addressed by President A. C. Humphreys, Mr. T. L. Jones, of the Brooklyn Edison Co., and Mr. R. D. Mershon, consulting engineer, on the subject "The Business Training of the Engineer." A remarkable attendance and animated discussion were features of the evening, the practicing engineers present insisting on a high ethical plane for the engineer.

The American Physical Society and the electrophysics committee of the American Institute of Electrical Engineers will hold a joint meeting at the Bureau of Standards on April 24 and 25. A feature will be an exhibit of physical apparatus by representative manufacturers.

The Western Society of Engineers has awarded Octave Chanute medals to Mr. W. L. Abbott, of the Commonwealth Edison Co., of Chicago, Mr. Onward Bates and Prof. D. W. Mead.

The midwinter meeting of the American Electric Railway Association held recently in New York was devoted to discussion of such subjects as "The Economic Aspects of Regulation Compared with Profit Sharing with Municipalities," "The Effect of Rate of Fare on the Riding Habit," "Inherent Hazards of the Electric Railway Industry" and "Present Day Influences of Labor on Legislation."

PUBLICATIONS RECEIVED.

Librarian's Report, 1912–13, of the Cornell University Library. This report states that 13,870 volumes were added to the library during the year. The recorded use of the books, representing probably about one third of the actual use made of the books in the library, aggregates 126,574 volumes.

Bulletin of the University of Illinois Experiment Station, No. 69, by F. C. Lincoln, 108 pp., price 50 cents. This well-illustrated BULLETIN contains a general account of the history, practice, results and costs of coal washing in Illinois. It is interesting to note that from 1906 to 1912 the production of bituminous coal in the United States increased

from about 342 million tons to over 450 million tons. Of this, in 1912 about 20 million tons were "washed."

The Technograph, Volume XXVIII, No. 2, contains several technical papers and other notes. Among them a fourteen-page article on "The Mechanics of the Gyroscope," by F. B. Seely, and in attractively illustrated article entitled "Indirect Lighting Applied," by L. V. James.

Reprint, from the *American Journal of Science,* Vol. XXXVII, February, 1914. An article on "A Progressive Development of Mechanics Based upon a New Form of the Fundamental Principle of the Science," by H. M. Dadourian. After reviewing the Newtonian and Lagrangian systems of mechanics, the author indicates a method of developing the science, which, it is claimed, eliminates the disadvantage or the discrepancies of the other systems.

The University of Nevada Sagebrush, Vol. XXI, No. 22, containing a discussion of the question of student control at the University of Nevada, and a historical sketch of "student control" of student activities at Columbia University.

Stevens Indicator, Vol. XXVI, No. 1, January 1914. Devoted to the first conference of the Associated Stevens Alumni Clubs, which was held on January 10, and the conference upon "The Engineer's Part in the Regulation of Public Utilities." The number contains a full length portrait of President Humphreys.

Science, N. S., Vol. XXXIX, No. 998, February 13, 1914, contains a paper on "Educational Interests at Washington," by Elmer Ellsworth Brown. A very readable resume of personal experiences and impressions gained as commissioner of education at Washington, with a discussion of the organization and scope of a possible national university.

Science, N. S., Vol. XXXIX, No. 1001, March 6, 1914. In this number there is a short article by P. N. Evans entitled "What Grades Represent." Apropos of the grading of a student, the author believes that the main factors represented by grades intelligently given may be described by the six terms: time, effort, mental ability, memory, language-sense and preparation.

Smoke Investigations, Bulletin No. 6, of the Mellon Institute of Industrial Research and School of Specific Industries, price 25 cents. This fifty-eight page pamphlet contains nine articles on the general topic "Effect of Smoke on Building Materials." It is felt that the efficient and enthusiastic work of the special staff of investigators will have a great deal to do with the awakening of the general public from its present apathy as regards the smoke nuisance.

Circular 24 of the Bureau of Standards is a pamphlet of 54 pages, which contains a list of the publications of the Bureau, consisting of 214 scientific papers, 31 technologic papers, 47 circulars of information, and 13 miscellaneous papers. Any of the separate papers in these four

series will be sent free on request. If you wish to receive a copy of Circular 24, giving titles and abstracts of each of the above papers, address a postal card to the Bureau of Standards, giving your name and address.

PERSONAL NOTES.

Professor D. C. Miller, of The Case School of Applied Science, has been delivering lectures on his specialty of researches in sound at several educational centers. He gave one on "The Physical Characteristics of Vowels" under the auspices of Sigma Xi at Cornell University on March 11. As is well known, Professor Miller has had remarkable success with his oscillographic apparatus for studying sound waves.

Professor A. C. Boyle, of Wyoming University, has been granted the degree of Ph.D. by Columbia University. He is professor in charge of mining engineering at Wyoming University.

Professor Ernest Merritt has resigned the deanship of the graduate school of Cornell University to devote himself more closely to research work in physics, in which he is associated with Professor E. L. Nichols, who is now dean of the college of arts and sciences.

Mr. Wm. O. Wiley, treasurer of the society, spent several days in Ithaca, N. Y., recently going over in detail, with the secretary, the methods followed in the latter's office.

Mr. H. H. Norris, secretary of the Society for the past five years and formerly in charge of the department of electrical engineering at Cornell University, is devoting a part of his time to editorial work with the *Electrical World* and the *Electric Railway Journal*. He is now spending a few weeks in New York, familiarizing himself with the routine of the editorial offices preparatory to devoting his entire time after July 1 to the *Electric Railway Journal*. His Ithaca office is still maintained and will be so until the expiration of his term as secretary of the society. Beginning May 1 he will devote most of his time to preparation for the Princeton meeting.

Mr. Geo. H. Shepard, formerly dean of the Smith College of Applied Science, Syracuse University, and now with the Emerson Company, efficiency engineers, is at present located at 414 Delaware Ave., Buffalo, N. Y. He is in charge of an important contract of the company in that region.

Professor A. H. Blanchard, head of the graduate department in highway engineering at Columbia University, has been delivering a number of out-of-town lectures this season. Among these were the following: January 26, The University of Illinois, "Bituminous Surfaces and Bituminous Pavements" and "Modern Developments in Highway Engineering in Europe"; on February 14, West Virginia University, "Park Boulevards," "Wood Block and Stone Block Pavements" and the two mentioned above; February 19, The Ohio State University, "Road Legislation, Present and Future," and the two delivered at the University of Illinois; February 24, The University of Tennessee, "Bituminous Macadam and Bituminous Concrete Pavements," "Highway Engineering in Europe" and an illustrated lecture on "City Pavements" before the Chamber of Commerce of the City of Knoxville.

Professor Wm. S. Aldrich, of the University of Arizona, recently delivered an illustrated lecture in the university's series, on "The Economic and Industrial Value of the Work of the U. S. Reclamation Service." Professor Aldrich was connected with the service for two years preceding his appointment as acting professor of mechanical and electrical engineering at the University of Arizona in the place of Professor W. W. Henley who is absent on sabbatic leave.

COLLEGE NEWS.

University of Alabama.—At an open meeting of the Engineers Club held recently, Mr. H. C. Mower, of Tuscaloosa, lectured on the Panama Canal, which he had visited in the fall with the American Society of Civil Engineers. He was for a number of years in charge of the design and construc-

tion of locks and dams, and is at present chief designer for the dam and controlling works at Lock 17 on the Black Warrior River.

University of Arizona.—A direct-connected steam generating set of 60-kw. capacity has been installed in the power plant, for light and power for the university laboratories, buildings and campus. Acceptance tests have been carried on in the mechanical engineering laboratory of a centrifugal pump for the university farm irrigation plant. A balancing rig has been set up, also, in this laboratory, for determining the vertical and horizontal balance of automobile engines, and small steam and gasoline generating sets. A small foundry equipment has recently been installed in the shops, for light casting.—University engineering extension has been taken up during this session. Evening classes have been established in drafting and shop mathematics, which are held in the rooms of the railway club of the Southern Pacific Railroad Company.—Evening classes have also been established in gasoline and automobile engines, at the university laboratories and drafting rooms. Both classes continue for twelve weeks, four hours weekly.—Tests have been made on the new system for heating the buildings, on the north side of the campus from the power plant, to determine comparative data with reation to the new boiler plant. This is to be operated with fuel oil. Complete rearrangement of steam and hydraulic piping in the laboratories has been made to adapt it to the new boiler plant and steam-heating system.

Brown University.—The faculty has approved changes in the curriculum recommended by the council of engineering professors providing for the broadening of the course and at the same time providing for some specialization. The changes, which affect the courses leading to the degree of bachelor of science in civil, mechanical and electrical engineering, involve the following provisions: (1) Concentration of the descriptive courses and introduction of new or optional courses in science and engineering; (2) better distribution of work throughout

the four years; (3) making the graduating thesis optional, with the approval of the head of the department concerned, and (4) providing for electives in engineering and science in the senior year. These changes are made to bring the practice of the engineering departments in line with that of other engineering schools.

Carnegie Institute of Technology.—Building is active this year, a total expenditure of $750,000 being involved in the four projects now under way. They include Machinery Hall which is to house the electrical and mechanical engineering departments and which is approaching completion.

Case School of Applied Science.—The school has purchased a church property for the purpose of remodeling it into a gymnasium, the plans for which were prepared by graduates of the school in architecture.—Recently the local members of the faculty gathered at the home of President Howe for informal discussion of the topics brought up at the Minneapolis meeting. The entire faculty of the school were invited as well as other local members of the society.—Dr. O. P. Hay, research assistant of the Carnegie Institution, recently lectured at the school on "The Ice Age of North America and Its Remarkable Animals."—Dr. D. R. Miller of the Case faculty recently delivered a series of eight lectures on the following topics at the Lowell Institute in Boston: Pitch, Loudness, Tone Color and Pure Tones; Methods of Recording and Photographing Sound; Effects of Horn and Diaphragm on Sound; Tone Qualities of Various Instruments, Ideal Tone; Physical Characteristics of Vowels and Other Sounds of Speech; Synthetic Reproduction of the Tones of Instruments, of Vowels and of Spoken Words.—The school recently conducted a series of lectures and tests in highway engineering with an encouraging enrollment of contractors, inspectors and state and county officials. The work was conducted under the direction of Mr. M. B. Greenough. Special lectures were delivered by experts in the practical as well as the theoretical side of the work.

Columbia University.—The department of highway engineering has been very successful during the present season in continuing the coöperation of leaders in the field. Among the recent speakers were Mr. P. D. Sargent, chief engineer, State Highway Commission of Maine; Mr. G. W. Tillson, consulting engineer; Col. J. W. Howard, consulting engineer; Mr. F. P. Smith, chemical and paving engineer; Mr. Harold Parker, manager, Hassam Paving Company; Mr. H. W. Durham, engineer of highways, New York; Mr. G. P. Hemstreet, superintendent, Hastings Paving Company; Major W. W. Crosby, chief engineer, Maryland Geological and Economic Survey; Professor J. Ansel Brooks, of Brown University; Mr. C. N. Forrest, chief chemist, Barber Asphalt Company; Mr. N. P. Lewis, chief engineer, Board of Estimate and Apportionment, New York, and Mr. J. A. Bensel, New York State Engineer.

University of Illinois.—This university also held a successful course in highway engineering with a registration of 191 and with an average attendance of 200 visitors. The speakers were chosen from the profession at large and from the engineering staff of the university An exhibit of road-building machinery was held in connection with the course. The course will probably be made an annual event.—The system of exchange lectures followed by the university for some time has resulted in bringing to Urbana many interesting speakers. Among the recent visitors was Professor L. D. Rowell, who lectured on "The Modern Battleship." Professor H. H. Stoek has been lecturing under this plan at several universities.—The department of railway engineering recently completed a series of car coupler tests of considerable magnitude.

Lehigh University.—Meetings of the engineering societies of Lehigh University, considered here as vital adjunct to regular classroom work, have been unusually well attended and interesting this winter. In addition to papers by student members, the societies were addressed by C. W. Rice, secretary A. S. M. E.; Alba B. Johnson, president, Baldwin Locomotive

Works; H. H. Smith, chief, research department, Edison Storage Battery Company; H. A. Hoffman, General Electric Company; Dr. L. I. Hewes, chief of economics, maintenance public roads, Department of Agriculture; J. F. Stevens, Philadelphia, representing the A. I. E. E., and Charles R. Underhill, chief electrical engineer, Acme Wire Company, New Haven, Conn.—The 1914 Register of Lehigh, just out, shows a total registration of 707 students, exceeding last year's enrollment by 35 and greater by 68 than that of 1912. The figures do not include the more than 200 students in extension courses. The geographical summary shows that Pennsylvania leads with 375 students; New Jersey is second with 72; Maryland, third, with 61; New York comes fourth with 53; and Massachusetts fifth with 20. Twenty-eight states are represented and 12 foreign countries; also Cuba and Porto Rico.

North Carolina College of Agriculture and the Mechanic Arts.—A new shop building is approaching completion which will, when completed, be one of the finest college shop buildings in the South.—The college will celebrate its twenty-fifth anniversary next October. The celebration will begin on Thursday evening, October 1, with an informal reception to visitors. Two meetings will be held the next day, one of former students, as class organizations, technical organizations, literary organizations, and the other all alumni. In the evening, addresses by former members of the faculty will be made. On October 3, which is the twenty-fifth anniversary of the opening, a large public meeting will be held, presided over by Governor Lock Craig, and a number of distinguished speakers will deliver addresses. In the afternoon there will be various athletic events. It is anticipated that many former students and others associated with the college will return for the celebration.

Stevens Institute of Technology.—Through the kindness of Mr. Calvin W. Rice, Secretary, A. S. M. E., the Stevens Engineering Society, which is affiliated with the A. S. M. E., has

received five beautiful engravings of noted engineers, presented by the Verein deutscher Ingenieure to the American Society of Mechanical Engineers, as a memento of the visit of a delegation from the latter organization to Germany last summer. The set includes pictures of Otto von Guericke, James Watt, Robert Fulton, Georg von Reichenbach, and Friederich Koenig, and is now on exhibition in the library.—Some interesting changes are being made in the woodworking course of the department of shop practice. The time assigned to bench carpentry and woodturning is being shortened in favor of a new course in wood construction coupled with some exercises in millwrighting. The new wood work is planned to give the student a knowledge of the mechanical principles of carpentry as shown in the construction of king-post and queen-post trusses for supporting heavy loads, framing floor beams around openings, trussing overloaded beams, timber construction for carrying heavy machinery, etc. It is believed that these changes will produce a course more closely fitting the requirements of the engineer, and that the students will take a livelier interest in this kind of work.

Massachusetts Institute of Technology.—A bequest of $4,000 was recently received by the institute to be used preferably to aid Jewish students.—Progress on the preparation of the site for the new buildings is rapid, several hundreds of men being engaged thereon. Already an aerodynamic laboratory has been constructed on the Cambridge site. This subject is being given considerable attention in a special course.

St. John's University, Shanghai, China.—An engineering course is being developed by Professor J. F. Putnam, formerly an instructor in Cornell University. One of the most difficult problems has been to teach the students that manual work is not degrading. They now think it quite interesting to take part in laboratory exercises and have even become enthusiastic over football, strenuous as that game is. St. John's sends one fourth of all the students sent to America from China, and is, therefore, an important educational factor in the country.

Professor Putnam has had to construct all kinds of machinery and he reports that he is able to get good work done from his designs. Labor is so cheap that the cost of materials only needs to be considered in determining the cost of apparatus.

University of Wisconsin.—Professor Geo. C. Whipple, of Harvard University, delivered a lecture before the Science Club recently on "Relative Values in Sanitation."—An engineering experiment station has been created by the board of regents. This will be established in the college of engineering and will have general charge of all testing and research work. Dean Turneaure will be director of the station.

INDUSTRIAL SAFETY CONFERENCE.

Recently there was held at the University of Nevada an industrial safety conference, under the auspices of the University Engineer's Club and the Nevada Industrial Commission. The meeting was well attended by a representative gathering of men from the various mines, railroads and state offices. The presiding officers were Hon. Tasker L. Oddie, governor of Nevada, and Prof. J. G. Schrugham, of the university. Most of the papers had to do with the "safety first movement," especially as concerned the railroads and mines. In this connection education of the men themselves as a means of the promotion of the "safety first" movement was frequently referred to and the point was made that success was due to men rather than to appliances. Guards can be easily and cheaply devised in most cases by the men most involved. About two thirds of the accidents are beyond the power of the employer to prevent and must be overcome by the education of the men themselves. Some of the addresses were: "'Safety First,' on the Oregon Short Line," by L. E. Abbott, safety commissioner for that line. Mr. Abbott emphasized the importance of the instructor's personality in reaching the men, and told of what was being done for the education of the men on his road.

"Safety First in Practice" was treated by Mr. Frank Ingram, secretary of the Brotherhood of Locomotive Firemen. The "Safety First" movement in Nevada was discussed by Mr. John J. Mullen, secretary of the Nevada Industrial Commission. "Safety First" regulations for electric power companies was discussed by representatives of the various power companies in this region. "Electric Headlights" was treated at length by Prof. Scrugham, and discussed by firemen and locomotive engineers. In the evening a comparative test was conducted on the Southern Pacific Road with two locomotives, one equipped with the arc headlight and the other with the nitrogen incandescent headlight. The results favored the incandescent form in that an object could be seen at a distance of one and one half times to twice as far away.

"The Nevada Industrial Commission" was the subject of a talk by Hon. Geo. B. Thatcher, attorney-general for Nevada. "Safety First in Mining" was treated by Thos. M. Fagan, president of the Tonopah Miners' Union. The paper on "Accident Prevention in Mining," by Edward Ryan, state inspector, told of what was being done and demonstrated the apparatus in use. "The Prevention of Accidents," by C. W. Price, safety engineer Wisconsin Industrial Commission, gave statistics and was a broad treatment of the subject.

A special meeting comprising an "Apprentice Instructors Section" was held at ten o'clock on Tuesday morning, January 27. This meeting is of special interest to this society as it was an expression of those giving instruction as a matter of business. The papers were as follows:

"Industrial Education," by Hon. John Edwards Bray, State Superintendent of Public Instruction.

"The Apprentice School System of the Southern Pacific Railroad," by Thos. G. Gray, of the Sacramento shops. The Southern Pacific apprentice system of instruction was inaugurated about a year ago and has developed to considerable proportions. The boys receive instruction during two periods a week. Each period is of two hours length. The classes are

held in the day time and the boys are paid for their time while in the class. Shop instructors are not at present employed. The system is being rapidly developed and will be of increasing interest to those interested in apprentice training.

"Mechanical Drawing for Apprentices" was very well treated by Mr. H. S. Gillette, of the West Oakland shops of the Southern Pacific, who described the development of the apprentice system of the New York Central Lines and told of what was being done at the Southern Pacific apprentice schools. One case was cited of the rebuilding of a locomotive, changing it from compound to simple, all of the work being done by apprentices under the direction of a single instructor. In the matter of developments, locomotive boiler sheets are laid out, the amount of lap allowed for and the position of the rivet holes shown by using stiff cardboard. The sheets are then put together to prove the work. A model of this kind was shown.

Mr. A. W. Preston, shop superintendent of the University of Nevada, read a paper on "A Proposed System of Railway Apprentice Instruction," advocating a more general training for the brighter boys, involving coöperation with technical schools on a part-time basis.

Mr. J. H. Linn, of the Santa Fé Railway Company, gave a valuable paper on the apprenticeship system of that road and told of what was being done to increase respect for the various vocational callings and the work that was undertaken to take care of the boy's development out of shop hours, and to direct his social welfare. The Santa Fé apprentice schools were started in September, 1907. They now have two dozen schools with 800 apprentices and 40 instructors.

The apprentice instructor has no other duties. The boys receive instruction two hours per day, twice per week for four years. Shop instructors are provided to see that the boys are given the necessary instruction at the time they most need it. They are at hand to see the work is done in the most correct manner, nothing being left to chance. A system of follow-up

reports is required from the shop foremen, shop instructors and apprentices, to the end that no kind of work is omitted and that a record of the boys' progress may always be at hand. The company maintains its own printing shop for the preparation of lesson sheets. The boys are encouraged to remain with the company after serving their time and a large majority do so. Each applicant is required to undergo a mental and physical examination before being admitted to the course.

The discussion at this meeting was particularly valuable. The necessity for having shop instructors for apprentices was very strongly felt by all present. Dependence on the workman or foreman is unjust both to the boy and to the other men. The foreman, with his other duties, ought not to be expected to instruct the apprentices. The boys are often backward about asking for help from other workmen and too often waste a large amount of time in devising ways of doing work. With a shop instructor the boys are directed in the proper way to do work and are changed from one kind of work to another at the right time. With an approachable and patient shop instructor the boys are properly trained and the regular shop force unimpeded.

THE TECHNICAL HIGH SCHOOL AND THE ENGINEERING COLLEGE.*

BY DEXTER S. KIMBALL,

Professor of Machine Design and Construction, Cornell University.

Professor Webb's paper contains much that may be read with profit both by the high-school teacher and the college professor. This is particularly true of what he says regarding the pressure that is being put upon our entire educational fabric to turn out men more nearly suited to the demands of industry. This is indeed a difficult problem and one that is going to be with us for some time. What he says regarding the stiffening of entrance requirements by making mathematical problems and other examinations more intricate, rather than more searching is also of interest. As a matter of fact, the entire question of entrance requirements and entrance examinations, as they now exist, are open to question and the near future will, no doubt, see some changes in the methods by which the fitness of a student is judged, so far at least as entering college is concerned. Whether these changes will take the form suggested by Professor Webb is, however, another matter.

There is a growing tendency in all technical colleges to recognize more fully the work of the high school and particularly that of the technical high school. This is illustrated in the entrance requirements of Sibley College, Cornell University, which are given below. The same requirements are asked by the college of civil engineering of the same university. It will be noted that aside from the fundamental requirements of English, history and the required mathematics, the requirements are very liberal, any standard language being accepted, and the list of electives being very liberal indeed, one unit in any high-school subject being accepted.

* Discussion of the paper on this subject by Professor H. E. Webb in the February BULLETIN, p. 56

List of Entrance Subjects.

NOTE:—The term unit means the equivalent of five prepared recitations a week for one year in a subject. See General Circular of Information for detailed information.

Group *a*.

Subject	Units
English A	2
English B	1
Algebra, Elementary	1
Algebra, Intermediate	½
Algebra, Advanced	½
Geometry, Plane	1
Geometry, Solid	½
Plane Trigonometry	½

NOTE.

Four-year Course: All seven units in Group *a* are required.

Five-year Course: From Group *a* five units are required, including
- English A & B ..... 3 units.
- El. Algebra ..... 1 "
- Plane Geometry ..... 1 "

Group *b*.

Subject	Units
History—Ancient	½ or 1
" Modern	½ or 1
" American, Civics	½ or 1
" English	½ or 1
German—First Year	1
" Second Year	1
" Third Year	1
French—First Year	1
" Second Year	1
" Third Year	1
Greek— First Year	1
" Second Year	1
" Third Year	1
Latin— First Year	1
" Second Year	1
" Third Year	1
" Fourth Year	1
Spanish—First Year	1
" Second Year	1
" Third Year	1
Italian— First Year	1
" Second Year	1
" Third Year	1
Spherical Trigonometry	½
Physics	1
Chemistry	1
Physical Geography	½–1
Biology	1
Botany	½–1
Zoology	½–1
Agriculture	½–1
Drawing	½–1
Manual Training	1
Any other High School Subject	½–1

NOTE.

Four-year Course: From Group *b* eight units are required, including
- Foreign Lang. (one). 3 units.
- History ..... 1 "
- Elective ..... 4 "

Five-year Course: From Group *b* ten units are required, including
- Foreign Lang. (one). 3 units.
- History ..... 1 "
- Elective ..... 6 "

Among the electives may be included Intermediate Algebra, Advanced Algebra, Solid Geometry or Plane Trigonometry of Group *a*.

While entrance requirements have been greatly liberalized as indicated by the foregoing example it does not follow that they have been, or that they will be, further changed to fit the work of the technical high schools more closely. On the other hand, they are likely, in the future, to be more easily met by the standard high school than by the technical high school. It will be noted that in the above example the mathematical requirement is high. This is necessary in order to enable the student to take up the mathematical side of engineering at the earliest possible moment. But, other sciences such as chemistry and physics are not required and in fact are not desired. Aside from the fundamental requirements and the mathematics the preparation of a boy for a technical course should be as broad and as liberal as possible. The boy who enters a technical college with the necessary requirements as outlined above and with a liberal background, say, four years of Latin and three years of German, will do just as well in his college work, other things being equal, as one who has prepared at a technical high school and who is better versed in mechanical matters. This is not a hypothetical statement but is based on a considerable experience with such students.

It must be remembered that as any profession grows in importance and undertakes to serve the public in a broad way its exponents must more and more become men of broad mind and liberal training. This is well illustrated in the tendency of colleges of law and medicine to require a definite standard of liberal training before admission to their curricula. The engineering colleges have been made to feel the same pressure and have been subjected to the criticism of turning out keen professional men who are lacking in broad vision, and, as a consequence, unfit to serve the state in a liberal manner. The liberal side of an engineer's training should be carried to the very door of the college, if possible, and as much liberal work should be given to him after entering as the course will permit. The technical high school is not, therefore, the most natural feeder of the technical college. When it has found itself it will be a feeder for the industrial field for those who cannot,

or who do not want to, go farther in their studies. It stands to the high-school class of schools exactly as the technical college stands in relation to the more liberal colleges of the university. This does not mean that students from technical high schools should not be admitted to technical colleges, nor does it mean that the work of these schools should not receive full recognition. It does mean, however, that for very best results the preparation of the embryo engineer should be as broad and liberal as possible up to his entrance into college. *Maturity of mind* is as much to be desired as specific training, if not more so. It is questionable if the necessary combination can be obtained by the use of technical and practical subjects alone. If the technically educated man is to rise to his highest usefulness he certainly must have a background of the history and ideals of the race of whose progress he is the most remarkable exponent.

A GERMAN PROFESSOR'S OPINION OF THE "SYLLABUS OF MATHEMATICS."

In the *Zeitschrift des Vereines Deutscher Ingenieure* for July 19, 1913, Professor Dr. P. Stäckel devotes some 1500 words to a very interesting and sympathetic review of the "Syllabus of Mathematics" published by this society.

After pointing out clearly the purpose of the Syllabus, which is merely to collect those facts and methods of elementary mathematics which a student of engineering should "know by heart," so that he will not need to look them up in a book, Professor Stäckel takes up the first three sections, on Elementary Algebra, Elementary Geometry, and Plane Trigonometry, and says that the material contained in these sections is less than that which is taught in the German gymnasia, but probably somewhat more than that which is actually retained as a permament mathematical possession by many German students after the lapse of a year or two.

Concerning the section on Analytic Geometry, he expresses the hope that the growing tendency to use the methods of

the calculus in analytic geometry will be encouraged in this country. He points out that the chief importance of the curves and surfaces of the second degree in applied mathematics is in connection with development in series, which can often be broken off with the term of the second degree. But since this is not always sufficient, he urges the extension of this section so as to include the higher algebraic and transcendental curves, as well as a more complete treatment of analytical geometry of three dimensions.

The section on Differential and Integral Calculus is confessedly incomplete, since it contains no discussion of functions of two or more variables. In the first chapter of this section, the distinction between (1) the graphical representation of a function, in which the units chosen on the two scales need not be equal, but should be suited to the size of the paper, and (2) the methods of analytical geometry, where the two scales are necessarily equal, is commended, especially in connection with the graphical definition of the derivative.

Many other suggestions of the Syllabus are also approved, as for example the distinction between the "elementary" sine of an angle, in degree measure, and the "higher" sine, in radian measure; and the equation $d \sin x^\circ/dx^\circ = (\pi/180^\circ) \cos x^\circ$ is commended to the attention of German text-book writers. Again, the advice concerning the use of tables of integrals, such as B. O. Pierce's, is heartily endorsed.

The treatment of differential equations is regarded as much too brief, and the absence of specific examples of the use of definite integrals in the determination of lengths, areas, volumes, moments, etc. (although these applications do not require any new principle) is deplored.

A number of omissions are noted, which the reviewer hopes may be included in a later section on numerical computation.

It is gratifying to observe that while Professor Stäckel finds much to criticize by way of omissions, he seems to find no portion of the existing Syllabus which he would wish altered, or removed to make room for material regarded as more important.

A NEW PLAN FOR ENGINEERING SOCIETY WORK.

BY FREDERICK L. EMORY,
Professor of Mechanics, West Virginia University.

As in other colleges the engineering students of the West Virginia University have had engineering societies of one kind or another for many years. In these attendance and participation were voluntary. Non-resident lecturers dropped in now and then, questions of current interest were taken up and formal papers were sometimes presented. The proceedings of the professional societies and engineering magazine articles were discussed. These meetings resulted in arousing various degrees of interest but the accruing benefits were largely monopolized by those who participated. To extend this usefulness various schemes were adopted hoping thereby to get all the students upon their feet for discussion, but with, at first, indifferent success. Being loaded with work they hesitated in taking on more. The only ones who took an active interest were the more mature men, who realized the great benefits arising from participation in the society's work. With a rearrangement of courses and requirements for degrees in the university, however, the opportunity came to give society work a better standing by making it a requisite course for all students in the junior and senior years. Under present conditions eight meetings are held each semester. Each student prepares four papers, two of which he reads and sustains before the society and two of which are held in readiness for presentation at any time after the date on which each is due. For the year's work a credit of one semester hour is given.

Of the four papers, assignments for two are accompanied by references selected by the committee having the program in charge. In preparing the other two, the student must use the library for his sources of information. Substitutions, except in debate assignments, are allowed when the student sug-

gests a topic of special interest to himself. Subjects that permit of profitable discussion are assigned to more than one member and on some evenings the meeting resolves itself into a discussion of a single topic, both sides being represented by assignment.

The program committee attempts also to assign subjects in the department in which the student is enrolled and he can thus obtain special assistance if such is needed. Subjects can be expanded by the instructor through the students' engineering society performance greatly to the help of his department and to the satisfaction of the student.

The subject of grading the work for which credit is given has been one of the problems in carrying along the work since not only preparation and attendance are necessary but some incentive to get the men on their feet must be included. At present the marks are made upon this basis:

For each of the four perfect papers, at 15 per cent.....	60 per cent.
For attendance, 8 meetings, at 5 per cent	40 per cent.
	100 per cent.

By way of discounts, a late paper coming upon a non-performance date can count but 10 per cent, and for encouragement a premium of $2\frac{1}{2}$ per cent for each 5-minute discussion at a meeting when not assigned is offered.

The present crowded courses in engineering tend to keep the student too close to the text-book, the laboratory and the drafting board. The Engineering Society makes the way easier to the university library, in fact it has multiplied the usefulness of the library many fold to the engineering student. Incidentally too it is a substantial preparation for his library work in connection with his thesis.

The members of the faculty are of the opinion that the society work is a valuable adjunct to the work of the class room and laboratory. It takes the place also of the old-time literary society activities. The great improvement, so plainly marked by better use of English, by freer and easier appearance before audiences of equals, by greater interest in work

and by better attitude toward associates, has proven the wisdom of making this society work obligatory.

Appendix I.

Partial list of subjects treated, each student having two subjects, each of broad, and limited scope.

Magnetic hoisting devices; safety devices to protect workmen; herring bone gears; principles of fire-resisting construction; shellac paints and varnishes; design of railway bridge abutments; relation of central station generations to railway electrification; where and when to use the gas engine; interior illumination; measurement of air in fan and mine work; lightning arresters for all chimneys; block system of signals for railways; principles of evaluating industrial property; self-hardening steels; manufacture of arc lamps; smokeless settings for boilers; failures of dams; principles of scientific management; comparative value of various railroad excavators; unipolar generator; average performance of lighting systems; life of Chas. Babbage; Helmholtz's contributions to knowledge; lighting of drafting rooms; interpole railroad motors; nitroglycerine and its uses in engineering; motor-starting currents as affecting transmission systems; garbage disposal; life and work of Jas. B. Eads; field systems; manufacture of tungsten lamps; comparative value of various calorimeters; anti-friction bearings; carts for civil engineering work; manufacture of sewer pipe; electric current rectifiers; steam cylinder performance; physiological effects of compressed air; good roads, local problems; wrought iron *vs.* steel for piping; flooring for manufacturing plants; sand-blast machines for bridge-work; life of Nikola Tesla; price-rate system; compressed air *vs.* electricity for mine-work; life of William Siemens; acid-proof coatings; concrete poles; manufacture of cement; steam meters; life of George Stephenson; train lighting; concrete as a reinforcement for steel; life of Lord Kelvin; cranes; lighting of mines; various insulations for heat, electricity, sound, water; various centrifugal pumps; scientific management; life of Jas. Nasmyth; brick and terra cotta columns; life and work of John A. Roebling; life of Sir Joseph Whitworth; lubricants and their efficiencies; water purification; street illumination; safety devices to protect workmen; electricity on the farm; water-proofing cement structures; painting iron and steel; sanitation of contractors' camps; modern high dams; spillways; manufacture of cement; brick and brick-making machinery; fireproof floor construction; search lights; bar *vs.* chains for coal cutting; Pitot tubes in the gas field; flaming arc lamps; tachometers and speedometers; economics of central steam heating; resuscitation after electric shock; commission control of public utilities; standard cross-sections; improvement of rivers; developments in the machine shop in last decade.

APPENDIX II.

A. Sample Assignment to a Junior.

(Each student receives a similar sheet with his work laid out for him at the beginning of each semester.)

Modern tool steel and high-speed tool alloys.
Life of Metcalf.
Gasoline *vs.* electric-motor vehicles.
Water purification by sedimentation.

B. Sample Assignment to a Senior.

Street illumination.
The researches of Coulomb.
Safety devices to protect workmen.
Development of electrical industries in 1913.

C. Sample Program for One Evening.

Water purification:
By ozone ..... T. J. B.
By ultra-violet rays ..... H. O. H.
By distillation ..... D. M. D.
By chemical precipitation ..... E. G. K.
Summer shop experiences ..... C. R. H.
Electricity *vs.* compressed air in mine work ..... H. L. R. and C. S.
Preparation of coal for market ..... F. T. R.
Spillways ..... B. T.
General Discussion.

SHALL WE TEACH ELECTROSTATICS OR ELECTRIC CURRENTS FIRST?

BY GUSTAV WITTIG,

Professor of Electrical Engineering, The University of Alabama.

Some time ago there was an interesting discussion in the pages of the BULLETIN on the teaching of physics. A period of silence has lately prevailed, but the matter is one of importance and interest in it must be widespread even if it is not manifested by written contributions. Without undertaking to re-open the discussion as a whole, I desire to touch on the teaching of one branch, electricity, and ask if there are any preponderating reasons why electrostatics should precede current phenomena in an introductory course.

ELECTROSTATICS OR ELECTRIC CURRENTS FIRST?

It is good sense and good pedagogy to base instruction on knowledge already in the mind of the pupil, proceeding, as the familiar expression states, "from the known to the unknown." In the case of physics the opportunity exists to approach the several subdivisions through the channel of common knowledge. This refers to the introductory course, rather than to more advanced analytical study. In attacking the latter, the student is supposed to know the fundamental principles and the general relation of the part he is studying to other parts of the subject, and the logical process is to build up from the simpler concepts and mathematical relations to the more complex. But in the general course he does not have that knowledge, and the logical sequence may be entirely different.

Leaving out of consideration the kinds of students we might have, and taking them as they really are, we are confronted by boys and girls who, in this day and generation, are bound to have more or less familiarity with electrical phenomena. It varies, with the individual, all the way from a perfectly astonishing ignorance and indifference up to the very respectable store of facts accumulated by the wide-awake boy with a healthy amount of native curiosity. Young persons thus equipped are to be given an understanding of physical laws and their applications, and are to be trained, so far as we can train them, in reasoning from observed phenomena back to causes, and forward from known facts and laws to probable results.

In regard to the electric current, many manifestations of its effects are matters of fairly common knowledge. The same cannot be said of static electricity. Just because of the air of mystery that still enshouds everything electrical in the popular mind despite this familiarity, and because in the case of electricity particularly we must confine ourselves to manifestations, it seems pertinent to ask, "Why not start with the familiar rather than with the unfamiliar phenomena? Is there any strong reason against it except tradition?"

Examination of a number of current text-books shows that

with few exceptions the chapter on static electricity is thrust like a dividing wedge between those on magnetism and current electricity. This is equally true of books on general physics and books dealing exclusively with electricity and magnetism. Let it be said again that there are exceptions, but they are not many.

For some years, in talks to present and prospective teachers of physics in secondary schools, I have suggested the plan of letting the study of current electricity follow magnetism directly. With a large class of students who were getting their introduction to the subject in the University of Alabama summer school, I used the same plan last summer. The effect on the students was satisfactory, and the instructor, for his part, can testify to a distinct feeling of mental comfort.

THE PRINCETON CAMPUS.

BY GILBERT F. CLOSE,

Editor of Official Publications, Princeton University.

The borough of Princeton, in which Princeton University is located, is an ideal university town of some five or six thousand inhabitants, without large commercial interests or manufactures, and therefore very attractive as a residential town. Its age and historic interest add to its attractions. Scattered along its thickly shaded streets are many fine old colonial residences, whose associations touch both state and national interest, and the development of the residential sections of the town in recent years, in which may be seen the work of several leading American architects, has made the oldtime village an unusually beautiful town.

The location of the university, in the center of this quiet residential town, and apart from the distractions of city life, has had a decided influence upon campus custom and manners, and has kept alive the subtle atmosphere of frankness and youthful enthusiasm that makes student life at Princeton so

attractive and wholesome. The students are free to live in a community of their own, and are dependent for their recreations upon their own resources and those of the generous outdoor world which surrounds them.

The central portion of the university campus, upon which most of the college buildings are erected, contains about 225 acres. Since 1905, however, several adjacent tracts have been acquired by the university, including the western portion, known as Springdale Farm, upon which the buildings of the new graduate college have been erected, and two other adjacent portions on the south and east. The university now has a total continuous campus area of more than six hundred acres. There are at present on the Princeton campus more than fifty college buildings, not including the handsome upper class clubs on Prospect Avenue.

The oldest and historically the most interesting building on the campus is, of course, Nassau Hall, which was completed in 1756. For over three quarters of a century Nassau Hall housed practically all of the undergraduates, and contained also the library, the prayer-hall, the dining hall, recitation rooms, and at one time a grammar school conducted in connection with the college. Nassau Hall was used at different times during the Revolutionary War as a hospital and barracks by both the British and the American troops, the closing scenes of the battle of Princeton took place about its walls, and in Nassau Hall also the Continental Congress sat for several months in 1783. It is now used as the university administration building, and the old prayer-hall, which has been handsomely remodeled and refitted, is now the meeting place of the university faculty. Upon its walls are portraits of presidents, officers, graduates, and other benefactors of Princeton. Here too is the full-length portrait of Washington, by Charles Willson Peale, in the historic frame that held the portrait of George II until it was destroyed by a bullet during the battle of Princeton.

Around this historic building has grown the extensive university campus of the present day. Behind Nassau Hall is

the main quadrangle of the campus formed by Nassau Hall, the university library, West College, the oldest dormitory now standing, and the white marble buildings of the two historic literary societies, Whig and Clio Halls. To the eastward lie the buildings of the John C. Green School of Science erected in 1873, and now used almost exclusively for the instructional purposes of the department of civil engineering; the chemical laboratory, built in 1891, and, like the school of science building, the gift of the John C. Green estate; Marquand Chapel, a brownstone building erected in 1881; Murray-Dodge Hall, the headquarters of the Philadelphian Society, the Princeton Young Men's Christian Association; and the two recitation buildings, Dickinson Hall, built in 1870, another gift of John C. Green, Esq., and McCosh Hall, a handsome new collegiate Gothic building, erected in 1907, by friends of the late President McCosh, and designed to meet the needs of Princeton's preceptorial system of instruction.

One of the leading factors of Princeton's undergraduate life has always been its dormitory system, and it is therefore natural that the dormitories form a large percentage of the buildings of the campus. There are now seventeen university dormitories, the oldest being West College, built in 1836, and the most recent Cuyler Hall, built in 1912. Some of the most attractive dormitories, architecturally, are Blair Hall, whose imposing fortress-like tower and arch forms the main entrance to the campus from the railway station, Stafford Little Hall, Culyer Hall, and Patton Hall. These dormitories, together with the massive gymnasium, form the defining contour of the western side of the main campus. Another imposing dormitory is Holder Hall, consisting of a quadrangle of buildings and a lofty and beautiful tower. The Holder group is the gift of Mrs. Russell Sage, and was given especially to provide dormitory accommodations for members of the freshman class.

The equipment of the university for scientific investigation has been very greatly increased in recent years. The Palmer Physical Laboratory, the gift of the late Stephen S. Palmer,

was built in 1908, and is devoted to the uses of the department of physics and electrical engineering. It is one of the largest and best equipped physical laboratories in the country. Guyot Hall, built in 1909, and named in honor of Professor Arnold Guyot, is devoted to the purposes of the departments of biology and geology, and contains, in addition to an adequate number of well-equipped laboratories, a large natural science museum. There is also a new vivarium, in which are kept a considerable variety of living animals and plants under the proper experimental and observational conditions.

The most recent addition to the collegiate Gothic architecture of the university is the Graduate College, built of native Princeton stone and located to the west of the main section of the campus, on the crest of a hill and commanding a magnificent view of the surrounding country. This imposing group, which was completed in the summer of 1913, and dedicated with impressive ceremonies on October 22, 1913, includes the John R. Thomson Graduate College, a residential hall accommodating about one hundred graduate students; Procter Hall, a handsome dining hall given by William Cooper Procter, '83, as a memorial to his parents; the Cleveland Memorial Tower, erected from popular subscriptions as a memorial to the late Grover Cleveland; the Pyne Tower, the gift of M. Taylor Pyne, '77, and Wyman House, the official residence of the dean of the graduate school.

Recognizing the educational value of good architecture, in academic buildings, the university has for a number of years been following a definitely formulated plan for the development of the campus. The architectural style of the buildings erected in recent years is the English collegiate Gothic, which adopts itself admirably to the broad slopes and natural unevennesses of the Princeton campus. As a consequence of this policy, the buildings of the Princeton campus possess an architectural beauty and unity not found, probably, in any other American college. A recent critic has declared that Princeton is "at present the most attractive architectural Mecca in the United States."

STUDENT CHARACTER RECORDS.*

BY W. M. RIGGS,

President of the Clemson Agricultural College.

How often do college presidents and other college officials receive letters like this?

Dear Sir: Mr. John Doe, once a student of your college, is applying for a responsible position with this company. Will you kindly give us a frank expression of opinion as to the character, disposition and ability of the applicant? Your anticipated reply, for which in advance accept our thanks, will be held in strict confidence.

Yours very truly, etc.

I find upon investigation that John Doe graduated seven years ago. I did not know him personally. I do not know who were his teachers, and if I did, it would be to find that many of them are no longer at the college. Time has dimmed the memory of those who remain. I find his grades in the office records. He was an average student, that is about all I can find out about him.

The Student's Rights.

Every student has a right to count as a business asset of no small value, the recommendations to which his life and work at college entitle him. But upon what shall I base an opinion of his character, disposition, energy, leadership, personal appearance, and those other qualities which mean more than do grades to my inquirer, and to the former student who has referred his prospective employer to me? At most, a grade is but a measure of brains and application combined; a sort of mental foot-pound as it were. But a foot-pound is not a suitable measure of volume or speed. And so a grade is not an appropriate scale by which to measure a student's

* Presented by title at a recent meeting of the Assn. of American Colleges and Experiment Stations.

personal or character qualifications. How, then, shall we manage to embalm and keep handy the consensus of opinion of his teachers regarding those vital traits of character and disposition which are the factors of one side of an equation, the other side of which is expressed in terms of success or failure?

A Practical Personality Record System.

The difficulty and embarrassment experienced by the writer led him to devise a system of recording estimates of those qualities which in the business world are put above mere class grades. The general method was first suggested by a system used in its Schenectady works, by the General Electric Company for keeping up with the progress and worth of student apprentices. The system, while radically different from ours because having a different end in view, suggested the application of like principles to college uses.

In brief, our method is as follows:

At the end of each session, teachers are asked to give opinions concerning the students who have come under their instruction for a sufficient length of time to enable them to form a just opinion. An estimate under each of the following headings is asked for:

(Freshmen) reputation for character, disposition, native ability, earnestness, promptness, accuracy, energy, gentility, personal appearance and neatness, class standing, preparedness; (juniors and seniors) technical ability; (juniors and seniors) leadership.

When the system was first inaugurated three years ago, numerals from *1* to *4* were used to express these opinions, *2* representing fair or average standing; *1*, excellence above the average; *3*, rating somewhat below average, and *4*, practical worthlessness.

However, this system of recording proved rather unsatisfactory, because the symbols used were all too familiar as applied to other purposes. An instructor could not make himself think in terms of "*2*" as a satisfactory standard.

After considerable thought, a set of symbols was adopted not so closely associated with the class-room. A straight horizontal line or dash is used to indicate the average or satisfactory standard in the particular characteristic under con-

THIS REPORT is to be forwarded through your Director with your Third Term Grades.

INSTRUCTOR'S CONFIDENTIAL REPORT

For Session Ending June 10, 1913

SENIOR CLASS, Section 2

NAMES	Character	Disposition	Native Ability	Earnestness	Promptness	Accuracy	Gentility (manners)	Personal Appearance	Class Standing	Preparedness*	Technical Ability**	Leadership**
DOE, J.	1	1	2	2	1	2	1	2	3		2	2
LONG, W. D	2	3	3	3	4	4	2	1	3		3	3
MANLY, E. T.	1	2	1	1	1	2	1	1	1		1	2
PERRY, O. G.	1	1	1	1	1	1	1	1	1		1	2
SIMPSON, H. N.	3	3	1	3	3	3	4	4	2		2	1
SMITH, S. G	2	2	1	3	3	3	2	2	3		2	1
NEW SYSTEM TO BE USED IN FUTURE												
DOE, J.	a	a	—	—	a	—	a	—	b		—	—

Use following Symbols: 1, good; 2, fair, average; 3, poor, below average; 4, worthless, bad; ?, not the slightest opinion one way or the other.

NOTE: Instructor's name will not appear on the permanent record.

*Answer only for Preps. and Freshmen. **Answer only for Juniors and Seniors.

Respectfully submitted,

W. W. WRIGHT Instructor.

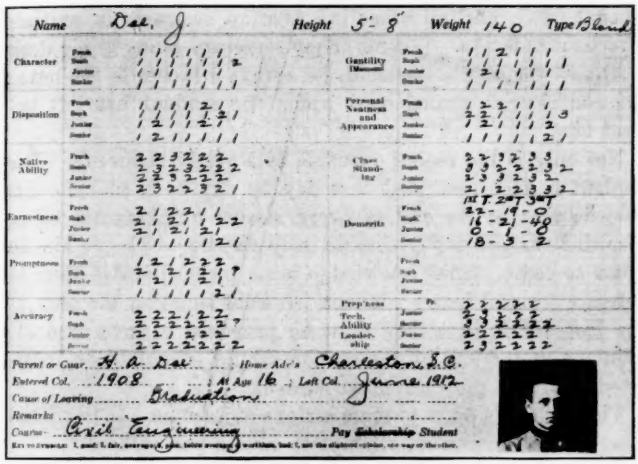
To the President.

sideration. An *a* above this line indicates exceptional quality, while *b* below the line indicates quality below the average. The letter *c* below the line indicates "conspicuous deficiency."

The teacher's report is made on a prescribed form (see illustration, one column being provided for the names, and another for the estimates under each heading. As it will not do to put a premium on laziness, the straight line indicating average quality is not printed on the blank form. If it were,

some of the reports would come back giving to *every* student this printed estimate of his qualities.

In order to insure candor of expression, the instructors are given to understand that their opinions will not involve them in any personal responsibility. It is the combined opinion, not any one individual opinion that counts. Instructors are urged to give sufficient attention to the students during the session to insure reasonably accurate and just opinions.


Name Dal. J. Height 5' 8" Weight 140 Type Blond

Character — Gentility — Manner

Disposition — Personal Neatness and Appearance

Native Ability — Class Standing

Earnestness — Demerits

Promptness

Accuracy — Prep'ness — Tech. Ability — Leadership

Parent or Guar. H. A. Dal ... Home Add's Charleston, S.C.

Entered Col. 1908 ... At Age 16 ... Left Col. June 1912

Cause of Leaving ... Graduation.

Remarks ...

Course Civil Engineering ... Pay ~~Scholarship~~ Student

Key to Grades: 1, good; 2, fair, average; 3, poor, below average; 0, worthless, bad; 7, not the slightest choice, one way or the other.

The grades as taken from the teachers' reports, are posted on a card. (See illustration.) A small picture of the student cut from a group picture is mounted in the lower right-hand corner.

The cards contain also information as to the weight, height, age, type, home address, date of entering and leaving college, cause of leaving, etc.

At the end of each session, a student will get from his teachers from eight to fifteen opinions. By the time he graduates, he will have recorded from thirty to sixty opinions as to his character, disposition, energy, promptness, earnestness, etc.

THE PLAN IN OPERATION.

My observation is that the record for any particular student, though marred occasionally by a "man eater" or by some opinionless and backboneless fellow, is generally quite consistent. Like the "shot-gun diagram" obtained in testing incandescent lamps, the cards show the *consensus of opinion.*

If you have ever known him, the photograph recalls the student to your mind, and you have before you his age, the duration of his stay in college, the course he took, why and when he left, and all other information desirable in writing a recommendation. Whenever my secretary sends to my desk a request for an endorsement, he always attaches to the letter the confidential record card which the student has left behind him.

Not only is the record valuable as a ready reference. The student is kept reminded that day by day he is making this record; that at the end of every session opinions are being recorded that, if not creditable, may rise up to plague him in years to come. Such knowledge is no inconsiderable spur to better work and better conduct. A knowledge on the part of the instructors that they must be prepared to give accurate opinions at the end of the session should stimulate an interested study of the individual student.

The system is open to some serious objections. It is offered merely as an imperfect attempt to meet a real difficulty.

In the first place, it is often difficult for a teacher to give accurate opinions if his classes are large and his hours limited. As a result, the card is likely to be partial to the student, for a teacher like a baseball umpire, when in doubt, usually and properly gives the benefit of the doubt "to the runner." Then too, in that strange collection, a college faculty, there will always be found a small precentage of reactionaries, who oppose any new idea and refuse to give more than perfunctory coöperation, whereas to be of value, a large amount of painstaking, conscientious labor must go into the job of making the records, which are turned in at the end of the session, both just and accurate.

Three years of experience has convinced me of the utility of these confidential character records. They are constantly consulted not only by the president, but by other officers of the college who have appointments to make, or recommendations to write. Almost invariably they can be depended upon to give to the student more than justice, and to the officer seeking information, a dependable basis for an opinion. The records show, in concrete form, the consensus of judgment of those best qualified by opportunity to judge the student.

I commend this system of student character records to colleges having at present only the class grades, in whose insufficient light to judge of those other and transcendant qualities which go to make up a man who is greater perhaps in every other respect than in mere scholarship.

COÖPERATION IN THE TEACHING OF ENGLISH TO ENGINEERING STUDENTS.

BY C. W. PARK,

Assistant Professor of English, University of Cincinnati.

At the request of several teachers of English, I present the following extract from a committee report adopted early last year by the engineering faculty of the University of Cincinnati:

"It is believed that the requirement of a uniform standard of expression in all departments is of advantage to students as well as to instructors. Only when the student has put his material in presentable form and has made his meaning clear, can the soundness of his conclusions be tested. Every piece of writing, therefore, whatever its subject, is first an exercise in English.

"The instructor in any subject has a right to insist that a written exercise be correct in form and clear in expression before the merit of its content is even considered. It is manifestly unreasonable to expect the instructor to decipher illegible manuscript, rearrange illogical combinations of data,

supply missing links in a chain of reasoning, overlook inaccuracies, and give the student the benefit of a hundred doubts. In all cases credit can properly be given only for what the student has actually said—not for what he might have said if he had formed a clearer idea of the subject, or if he had taken more pains to express his meaning.

If careless writing is an imposition on the instructor, it is a far greater detriment to the student. Written work, if properly done, trains the student to be neat, systematic, accurate, and capable of consecutive thinking; and therein lies much of its value. If the work is carelessly done, not only is this training lost, but the student becomes confirmed in bad habits of expression which no course in English Composition can correct.

"It is recommended, therefore, that all engineering students be required to maintain a definite standard of expression in all their written work, and that a grade in English be given each student for each term throughout the five years of his course."

It may be well to explain that this report was the outgrowth of several years of experience in coöperation between the department of English and other departments of the college of engineering. A working agreement had existed among instructors, to the effect that no credit should be given in any subject involving written work, if the English grade for such work was below passing. The other side of the reciprocity agreement required that a part of the instruction in English should be based on the written work done in other courses. Since the plan had been thoroughly tested in this manner, its unanimous adoption as a general policy was rather the ratification of an old system than the establishment of a new one.

The effect of this system of coöperation has been to improve the quality and to raise the standard of written work in all departments. The students recognize the importance of English composition, and the improvement in their writing bids fair to be permanent, for it is no longer based on a desire merely to secure a passing grade in a required subject.

SCIENTIFIC GRADING AND THE REED COLLEGE SYSTEM.

BY WINSLOW H. HERSCHEL.

Assistant Physicist, U. S. Bureau of Standards, Washington, D. C.

Faculty and students alike dread examinations. Some of the former regard them as an unavoidable evil, while others declare them unnecessary, because any instructor, unless he has an abnormally large class, is able to tell who should, and who should not pass, long before the time for the final examinations arrives.

Examinations Necessary and Desirable.

The best man in the class might frequently be selected during the first week of the semester as a student certain to pass, yet no one would consider it proper, on this account, to excuse him from further attendance. Nor should the discovery, at a later period, that other members of the class would be sure to pass, be sufficient reason for excusing them from further work. The final examination serves as a means of training students, as well as of selection. A dull student may by diligence and the expenditure of much time and effort, be able to make a creditable showing in recitations or problem books. It is only in examinations that each and every student is limited to a specified period of time. The time element is most important in remunerative work after graduation, and the cultivation of the ability to accomplish an allotted task in a stated time is an essential part of education. When our immediate superior, in almost any walk of life, gives us a problem, we know without being told that he wants the answer as soon as possible, and that he will judge our ability or fitness for our position to a large extent by our promptness in obtaining a correct answer. Yet the tendency here is for instructors to inform students, in an apologetic tone, of an approaching examination, in striking contrast to the situation in Germany where the student must petition for an examination!

The Educational Value of Examinations.

Much of the tendency to relieve students of examinations, or of other things that are distasteful to them, rests, it seems to me, upon a mistaken feeling of kindness toward the student. Yet students come to college, or should do so, primarily to fit them for their life's work, and it is no kindness to them to yield to their strange desire to get as little as possible for their money. Translations at sight and the solution of original problems have made the work in examinations approach more nearly the conditions of every day life. We might go still further in this direction, and allow text books to be used in examinations, were it not for the expense of supplying them, and the impracticability, for obvious reasons, of allowing students to use their own. It is however possible to give a student data or formulæ on the examination paper, so that his ability to reason is tested rather than his memory. Such examinations give a training which is a direct preparation for subsequent work, and to permit a student to omit an examination is to deprive him of a valuable part of his education.

The Selective Value of Examinations.

In general there appears to be a great deal of misplaced leniency shown toward students. We are all of us fitted by nature to do something or other better than anything else, and the sooner we find out what line of endeavor will permit us to appear to best advantage, the better for all concerned. It is no favor to a student to let him scrape through from one class to another, when a little less leniency would convince him that he was on the wrong track, and start him along some other path where he could distinguish himself. Mr. Frederick W. Taylor has met with the same misplaced sympathy in his work of introducing scientific management. His remarks concerning some pig iron handlers who were "weighed and found wanting," applies equally well to students. "It should be understood that the removal of these men from pig iron handling, for which they were unfit, was really a kind-

ness to themselves, because it was the first step toward finding them work for which they were peculiarly fitted, and at which, after receiving proper training, they could permanently and legitimately earn higher wages."

Justice in Examining and Grading.

As examinations are necessary, it is most important that justice be done, not only in determining who shall be required to repeat work poorly done, but also who shall receive honors, scholarships or other rewards. As long as every student followed the same curriculum, a fair comparison between different men was comparatively easy. Now, under the elective system, where the work of one student is obviously more extensive or more difficult than that of another, some are handicapped in the struggle. Though a degree from one college is not worth as much as a degree from another, allowances can easily be made for the difference because a loyal graduate never hesitates to mention his *alma mater*. In some institutions the degrees with distinction—*cum laude, magna cum laude,* and *summa cum laude*—help to distinguish the students who have given good measure in their work for the degree, from those who have barely filled the requirements. There is also a growing tendency to require for the degree a certain percentage of marks of higher grade, so that the man who has merely passed all the required work with the lowest mark, is not entitled to the degree. But such restrictions are of little value as long as there are elective studies, which soon become known to the student body, in which high grades may be obtained with less effort than is needed to obtain a passing grade under a "hard marker."

All instructors, we trust, try to be just, and many try to be generous, overlooking the fact that leniency toward a poor student is an injustice toward the good ones. The value of most everything in the world is directly in proportion to its scarcity. The choicest goods are always done up in the smallest packages. The invention of the process for making

real rubies artificially (or at least rubies so nearly like the genuine that they can not be detected by an expert has not changed the beauty, but merely the scarcity of rubies, and hence their value. It is the scarcity of platinum, due to its use in electrical apparatus, that has caused it to be considered appropriate for jewelry. Thus marks of *A* and *B* and the degree A.B. lose their value if too freely given. The intended generosity defeats its own end.

IMPRACTICABILITY OF MATHEMATICAL ACCURACY IN MARKING.

Some instructors claim that it is possible to mark a paper correctly to within 1 per cent. of what it is worth, but even if this were so, the question would remain whether it was possible to prepare an examination paper to within 1 per cent. of the proper difficulty. The purpose of an examination is to separate the better from the worse. If the result is that nearly every student gets *A*, or nearly every one fails, the instructor has not succeeded in his object. Just as in photography, if a slight error is made in exposure, it may be remedied to some extent in the development, so, if an examination is too hard, it may be marked leniently, and if it proves too easy, it may be marked more severely. Obviously it can not be determined whether the standard has been set too high or too low until the result of grading several papers has been noted. It is therefore necessary to grade a few papers, determine the difficulty of the examination, mark the remaining papers, and lastly remark the first few. Or, where grades are reported in letters, it is convenient to mark all the papers in per cent, and then, after noting the severity of the examination, establish the relation between grades as expressed in per cent. and in letters.

To my mind there can be no such thing as absolute accuracy in grading except under the supposition that it is proper to mark a mathematical problem perfect, if the answer is correct, or zero if it is wrong. If this is not done it must be merely a matter of judgment how much to deduct for errors. Suppose for example that a problem would be marked *10* if perfect.

If a careless mistake is made by writing a plus for a minus sign, should the mark be *9*, *8* or what? Should a mistake in an exponent be regarded as more or less serious than a mistake in a sign? Or, considering English composition, we might for example adopt some arbitrary system that a mistake in punctuation reduced the mark to *9*, one in spelling brought it down to *8*, and one in syntax reduced it to *7*. We might rigidly adhere to our rule, but it would be impossible to prove that the scheme adopted was absolutely just.

We must give up the idea of fine distinctions without significance. Just as we find some embryo engineers who guess at a coefficient which may be 10 per cent in error, and then figure out the answer to five or six significant figures, so we find instructors who have no fixed rule about preparing an examination paper, and yet who conscientiously split hairs over fractions of one per cent in marking. Such instructors regard the system of marking by letters as inaccurate and unfair, yet it may be shown that five letters, each used with a plus or minus, gives as many grades as are warranted. President Wm. T. Foster, of Reed College, says, "Ten rather than any other number of grades are used because tests by approved statistical and psychological methods show that fewer grades are inadequate to designate readily discernible differences, and many more grades can not be used with intelligent discrimination."* As a matter of fact, under the percentage system of marking, only ten grades are used, an examination paper being most generally divided into ten questions, and each one graded on the scale of *10*. The absurdity of attempting to use a hundred different grades becomes evident in a drawing-room course, where one plate corresponds to an examination, and we attempt to decide whether a fair drawing should be marked 82 per cent. or 83 per cent. It is also a question whether 83 per cent. means 83 per cent. of perfect as we fondly imagine. Instructors can not always judge abso-

* *Science*, June 7, 1912, p. 887.

lute perfection, and practically, *100* does not mean "perfect," but "perfectly satisfactory" to the instructor.

Assuming that an instructor can correctly determine the relative ability of his students by examination and otherwise, there remains the problem of settling what proportion of these students should be allowed to pass, either on absolute or relative grounds. If an instructor has the idea that students must know a certain definite amount, to do credit to the school or to himself, before they should be allowed to pass, the result is apt to be a high percentage of failures. High standards are admirable, but there is one consideration that is often overlooked. No instructor can increase the knowledge or ability of his students more than a certain amount in a given time, so that in the last analysis the ability of the graduates of a school must depend in large measure on the entrance requirements, over which the instructor probably has no control.

There is need of both an absolute and a relative standard. It is not necessary that the highest mark should always be given. It may be withheld if no candidate seems to deserve it, just as is often done in prize competitions. It is not necessary either that any one should fail in a small class, as the poorest student in a small class one year might be doing better than the average work of another class another year. While great freedom is allowed instructors as regards the number of men they may "fail" without comment (except from the students) yet if one should "pass" less than half his class he would probably hear of it. It was the abuse of this freedom at the University of Missouri which led to the adoption of a rule that with five grades, half of the marks given by each instructor, must, in the long run, be of the middle grade.

Recent Scientific System of Grading.

The Missouri and other similar systems are based on the curve of probability which has the equation

$$y = e^{-\frac{x^2}{2}}$$

or, roughly, the shape is that of a gendarme's hat. The use of the curve is based on the fact that, for individuals selected at random in sufficiently large numbers, mental as well as physical characteristics will be distributed in accordance with this curve, that is, the percentage of the total number of individuals considered, attaining any degree of excellence covering a range represented by the distance between two ordinates, will be proportional to the area bounded by the curve (which forms the top of the gendarme's hat), the horizontal base formed by the axis of x, and the two ordinates. The Missouri system consists essentially of the administrative policy, that each instructor should give out, in the long run, approximately the same proportion of marks of each grade as any other instructor, the proportions being in accordance with an adopted standard. At the University of Missouri a faculty committee has charge of the administration of this rule.

It seems reasonable that each grade should cover the same range of ability, just as when *A* signifies 91 per cent. to 100 per cent., *B*, 81 per cent. to 90 per cent., etc., although in a modification of the Missouri system adopted at Reed College, as well as at the University of Missouri, different grades represent unequal ranges of ability. Assuming all ranges equal (except that of the extreme grades) it is only necessary to decide on the number of grades desired, and the percentage in the extreme grades, to determine from the probability curve the proper percentages in the other grades. This may be done by a table of integrals, or by any other means of determining relative areas. It should be noted that the ends of the surface bounded by the curve and the base, are long and tapering, theoretically infinite in length, so that the extreme grades must of necessity have infinite range. The ranges of all other grades may be kept equal.

Table I shows the distribution of grades in per cent., assuming ten grades, for various assumed values for the extreme grades. Any line in the table might be adopted as a system of marking, with equal claim to being a scientific system. If we add together columns 1 and 2, 3 and 4, etc., we obtain other

systems with five grades, as given in Table II; and if we retain the extreme grades as in column 1 of Table I, and add columns

TABLE I.

TABLES SHOWING DISTRIBUTION OF GRADES IN PER CENT., EACH REPRESENTING AN EQUAL RANGE OF ABILITY, WITH THE EXCEPTION OF EXTREME GRADES.

Grade Nos.									
1	2	3	4	5	6	7	8	9	10
0.2	1.3	6.0	16.1	26.4	26.4	16.1	6.0	1.3	0.2
0.4	1.9	6.9	16.0	24.8	24.8	16.0	6.9	1.9	0.4
0.6	2.4	7.4	16.1	23.5	23.5	16.1	7.4	2.4	0.6
0.8	2.7	7.8	16.1	22.6	22.6	16.1	7.8	2.7	0.8
1.0	3.0	8.1	16.0	21.9	21.9	16.0	8.1	3.0	1.0
1.5	3.7	8.6	15.7	20.5	20.5	15.7	8.6	3.7	1.5
2.0	4.1	9.1	15.0	19.8	19.8	15.0	9.1	4.1	2.0
2.5	4.6	9.3	14.8	18.8	18.8	14.8	9.3	4.6	2.5
3.0	4.9	9.5	14.5	18.1	18.1	14.5	9.5	4.9	3.0
3.5	5.2	9.4	14.6	17.3	17.3	14.6	9.4	5.2	3.5
4.0	5.5	9.5	14.0	17.0	17.0	14.0	9.5	5.5	4.0
4.5	5.5	9.8	13.6	16.6	16.6	13.6	9.8	5.5	4.5
5.0	5.8	9.6	13.7	15.9	15.9	13.7	9.6	5.8	5.0
6.0	6.1	9.7	13.0	15.2	15.2	13.0	9.7	6.1	6.0
7.0	6.4	9.6	12.6	14.4	14.4	12.6	9.6	6.4	7.0
8.0	6.5	9.4	12.4	13.7	13.7	12.4	9.4	6.5	8.0
9.0	6.6	9.6	11.5	13.3	13.3	11.5	9.6	6.6	9.0
10.0	6.9	9.2	11.4	12.5	12.5	11.4	9.2	6.9	10.0

2 and 3, 4 and 5, etc., we obtain six grades as in Table III. It will be seen that by starting with other even numbers of divisions (8 or 12, for example, instead of 10), many more systems could be obtained, all from the same normal curve of probability. Thus if eight divisions were used in Table I, Table II would have 4 grades, and Table III would have 5.

CONCLUSIONS.

As college students are not selected at random, but by examination, it is claimed that the normal curve does not apply, and that on this account the system of percentages should be unsymmetrical. Leaving out the extreme grades which are expected to be attained by less than one per cent. of the students, the Reed College system is as follows:

No. of grade	2	3	4	5	6	7	8	9
Percentage of students attaining that grade	5	10	15	20	25	15	6	4

It is evident that if, as in the Reed College system, neither equality of range of the different grades nor symmetry of the

TABLE II.

Grade Nos.				
1	2	3	4	5
1.5	22.1	52.8	22.1	1.5
2.3	22.9	49.6	22.9	2.3
3.0	23.5	47.0	23.5	3.0
3.5	23.9	45.2	23.9	3.5
4.0	24.1	43.8	24.1	4.0
5.2	24.3	41.0	24.3	5.2
6.1	24.1	39.6	24.1	6.1
7.1	24.1	37.6	24.1	7.1
7.9	24.0	36.2	24.0	7.9
8.7	24.0	34.6	24.0	8.7
9.5	23.5	34.0	23.5	9.5
10.0	23.4	33.2	23.4	10.0
10.8	23.3	31.8	23.3	10.8
12.1	22.7	30.4	22.7	12.1
13.4	22.2	28.8	22.2	13.4
14.5	21.8	27.4	21.8	14.5
15.6	21.1	26.6	21.1	15.6
16.9	20.6	25.0	20.6	16.9

TABLE III.

Grade Nos.					
1	2	3	4	5	6
0.2	7.3	42.5	42.5	7.3	0.2
0.4	8.8	40.8	40.8	8.8	0.4
0.6	9.8	39.6	39.6	9.8	0.6
0.8	10.5	38.7	38.7	10.5	0.8
1.0	11.1	37.9	37.9	11.1	1.0
1.5	12.3	36.2	36.2	12.3	1.5
2.0	13.2	34.8	34.8	13.2	2.0
2.5	13.9	33.6	33.6	13.9	2.5
3.0	14.4	32.6	32.6	14.4	3.0
3.5	14.6	31.9	31.9	14.6	3.5
4.0	15.0	31.0	31.0	15.0	4.0
4.5	15.3	30.2	30.2	15.3	4.5
5.0	15.4	29.6	29.6	15.4	5.0
6.0	15.8	28.2	28.2	15.8	6.0
7.0	16.0	27.0	27.0	16.0	7.0
8.0	15.9	26.1	26.1	15.9	8.0
9.0	16.2	24.8	24.8	16.2	9.0
10.0	16.1	23.9	23.9	16.1	10.0

system is preserved, there remains little to show that it is based on the curve of probability, and there is no limit to the number of systems which can be devised. Presumably an unsymmetrical system, based on a skewed curve, as it is called, is preferable to a symmetrical one, but it remains a question how much it should be "skewed."

Under the circumstances it would appear desirable to adopt a symmetrical system temporarily, and trust that sufficient data may be accumulated in the future to make it possible to select a skewed curve on a scientific basis. The adoption of almost any curve is a step in the right direction, for it would at least secure the uniformity which is at present sadly lacking.

ACADEMIC EFFICIENCY—UNDEFINED AND UNREWARDED.

BY LEONARD M. PASSANO,

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Much has been written of late upon the subject of the application of the principles of scientific management to the educational institution. What has been written has been, for the most part, general and discursive; an expression of opinion merely and without the weight of authority. There has at length appeared, however, what may be considered an authoritative statement on the subject,[1] a statement which it may be well to subject to analysis in view of the importance of the questions involved.

Dr. Person, after premising that his discussion is to be "concerned with the business of academic instruction . . . ; with formal instruction of the class room and with that informal instruction which operates outside the class room," and concerned with these only, sums up the objections to the application of scientific management in education in the following paragraph.

> The product of an industrial plant is a material thing, capable of precise measurement, qualitatively as well as quantitatively; the product of an educational plant is the scholarship, culture and manliness of its graduates, attributes quantitatively and qualitatively immeasurable. The processes of an industrial plant are mechanical and subject to exact and known laws and subject to precise variation in application with reference to their effect; the processes of education are functions of the contact of minds and personalities. The material of the industrial plant is matter, capable of as precise quantitative and qualitative measurement as is its product; the material of the educational plant is the human

[1] "Academic Efficiency," by H. S. Person, director and professor of organization and management, The Amos Tuck School, Dartmouth College. In the BULLETIN OF THE SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION, Vol. IV, No. 2.

mind and human nature, intangible and immeasurable, and never the same in two individuals. The principles of the organization and administration of the one cannot be therefore the same as those of the other.

The above may not be considered a fair or adequate statement of the case, but may, nevertheless, be accepted for the sake of argument and as giving no unfair advantage to the opponents of scientific management. In criticism of these objections Dr. Person says, that they consist "simply [of] statements of opinions unsupported by data of experience or investigation, unsupported even by argument. The few that do present argument present *a priori* argument only and all essentially the same *a priori* argument," namely, as given above. There can be no objection to *a priori* argument if it be based upon true premises, and the assumptions underlying the above argument, says he, "in a large way are true," but they "should be subjected to investigation and experiment."

We contend that these assumptions, these premises, are the result of investigation and long experience. To a less extent they are based upon experiment, for the experimental method is not so clearly applicable to human beings as to things; especially where the success or failure of an experiment may affect the comfort and happiness of a generation. We contend that these assumptions are based upon the experience and knowledge of past generations of educators, men not wholly ignorant of the workings of the human mind in arts, in letters and in the sciences, though ignorant perhaps of the supreme science—of management.

The science of management would have been welcomed by those men as it is welcomed by their successors. They would have accepted its laws and applied its principles, and we may do the same; asking only that its laws be shown to rest upon scientific fact, or at least upon valid scientific hypothesis, and that its principles be shown to be applicable to the field of education. The burden of proof rests upon the innovators.

But, says Professor Person, "the *a priori* arguments against the applicability of the principles of scientific management in instruction . . . are grounded upon false premises; . . . they

premise a Mark Hopkins, a log and one student, whereas our educational institutions are great aggregations instructed in groups; and that in so far as personal contact between instructor and student tends to diminish, organization must become more complex if efficiency be preserved. As organization becomes more complex the principles of scientific management become more applicable." Is there no *a priori* argument here, based upon false premises? The author *says*, "our educational institutions are great aggregations instructed in groups." He *means* that our educational institutions are great aggregations instructed in *large groups, with little or no personal contact between teacher and student;* and it is upon the premise stated in this latter form that his argument is founded.

It has already been said that our premises are based upon long past experience. We shall presently show that the educator's ideal is not the Mark Hopkins college and shall point out that growth and complex organization do not necessarily involve loss of personal contact between student and teacher. We deny that "as organization becomes more complex, the principles of scientific management become more applicable." If they are *scientific* principles they should be more readily applicable to the simple case than to the complex. Moreover, the applicability of these principles to the educational institution is the very question in dispute, and the author quietly injects here his thesis as a valid premise for his argument. Finally, he tacitly assumes the superiority of "scientific management" to any other form of management of the complex educational organization. Having exposed thus his insecure foundation, let us proceed to test the stability of the edifice erected thereon.

The scientific manager concedes that there is one system not inferior to his own. "I know," he says, "of no more efficient educational organization . . . as to personnel, equipment or method," than the ideal Mark Hopkins college. But to many educators it seems that this ideal may be, and in some instances has been, improved upon. Mark Hopkins—we must

have the gifted individual—with a class of fifteen students would seem to be a more perfect combination still. The contact, the friction, the interplay of the minds of such a group of teacher and students is more stimulating and helpful both to learner and teacher than is even the harmony of that famed duet.

The combination of a gifted and sincere teacher with a small number of earnest and industrious students would seem to be the highest ideal of the educational institution. It is an ideal perhaps not easily or often realized, for "the supply of Mark Hopkins is limited," and our colleges have grown to such numbers as "one, two, three, four and even five thousand students"; so that "personal contact between instructor and student diminishes . . . to almost nothing, and . . . efficiency in organization must make up for diminished personal contact."

Waiving the question whether efficiency in organization *can* make up for diminished personal contact, we may deny that it *must*. The obvious and best remedy for the evil would be to increase the supply of Mark Hopkins to meet the demand of a college with an enrollment of even five thousand. Possibly, too, it may be found that a college of five thousand students is neither necessary nor desirable. Such numbers may be due to accretion and not to growth. The remedy may lie partly in the discontinuance of the covert advertising of the rival educational factories, and partly in a reversion to older and saner ideas as to the college and the college student; to the idea of the college as a seat of learning, and to the idea of the student as an earnest seeker after knowledge. The college might then be both smaller and better.

If, however, the large college be a normal growth, it may reasonably be assumed that the growth in numbers of gifted teachers is commensurate. They may not now be teaching, but if the demand is made the supply will be forthcoming; that is, if the rewards are made, not alluring indeed, but merely ample. Not every man possessed of a high order of teaching ability is willing to become a follower of St. Francis.

Is not this the true crux of the matter; namely, the cost? And is not scientific management applied to education an effort rather to provide a moderately good education at a low cost, than to provide the best education at whatever cost may be necessary? Certainly, and justly, scientific management, as applied to commercial enterprises, has for its chief aim the earning of greater profits by a reduction of the costs, and it is reasonable to believe that it carries its aims, as it carries its principles, into the field of education.

Even if the cost of increasing the supply of Mark Hopkins be prohibitive, does it necessarily follow, as is asserted, that organization is preferable to the small personal contact in large classes? To many it seems that the inspirational value of lectures to large classes is underestimated. Phillips Brooks, preaching ideals of duty; Agassiz lecturing on zoölogy; George William Curtis, pleading for civil service reform; Poincaré, describing the evolution of stellar systems, might inspire audiences of even a thousand undergraduates. And lesser men to smaller numbers do, in their lectures, give to their audience an inspiring knowledge of literature, history and science. Many of their listeners doubtless go away uninstructed and unrefreshed. Such would depart famished from the springs of Helicon and uninspired from the voice on Sinai.

With these, what shall be done? The answer of scientific management applied to education is, refer them to "functionalized advisors, picked men" who spend their days in giving advice to five thousand students, and who do nothing but advise; who "save much wasted energy of students by relieving them of the necessity of deciding the *how* in situations which they have not the experience to decide safely." Then if the advice is scorned or neglected the student is turned over to the "functional disciplinarian" whose painful and perpetual duty is obvious.

Granting the desirability of "functionalized" advice and discipline, where are the administrators of such duties to be found? Is the giving of advice to a thousand, even to a hundred young men, on every question that may arise as to their

duty, their work or their profession, so simple a matter that men to fill such offices can be easily found? In an individual case where will the "functionalized advisor" get the information on which to base his advice? He will get his "scientific" data from the previous records of the student, from information which the student volunteers or which is elicited by cross examination, and from information furnished by the young man's teachers. This is all second-hand information, data secured by consulting authorities and not by original research. The original investigator of the student, he who knows the youth most intimately, is his teacher, and to him the other sources of information are equally open. Unless the professional advisors are men of far greater breadth of outlook, worldly wisdom, and insight into the human character than are the teachers in our colleges, the latter would seem to be much better fitted to advise the student in his perplexities. But if the advisors are men of such transcendent ability they must, we warn the scientific manager, be paid for.

There are indications, however, that under scientific management advice and discipline, as well as teaching, are to be "standardized," with a consequent enormous gain in simplicity. Student A consults Advisor B who fills out a blank form stating A's age, height, weight, his brachycephicality or dolichocephicality, his reaction time, his coefficient of intelligence—previously determined by the functionalized psychometrist—all the scientific data of his case, which need not be enumerated. Then Advisor B, after consulting his catalogue index and shuffling the cards, hands to student A advice DnKy, to be followed, if the advice prove inefficacious, by discipline ROd4. Truly, as we have remarked, an enormous gain in simplicity!

Indeed, why should not the principles of scientific management be carried to the logical extreme in education? With "functional teaching . . . functional administration (discipline), functional advising and functional supervision and guidance of non-classroom educative influences," why should not youth engage in functionalized study, receive a functional-

ized degree, and thence, with a functionalized education, pass onward to the functionalized battle of life?

With this compare the chaotic state of actual education in which "the obligations of the instructor embrace practically all institutional functions except general administration," for which last even, to the wonder of the scientific manager, there seems to have arisen a demand on the part of the teaching force. The instructing staff seems to wish to increase rather than decrease the number of its functional activities.

However that may be the teacher undoubtedly has many and divers functions to perform; too many, say the advocates of scientific management; so many that "none is performed efficiently, not even instruction itself as efficiently as it might be."

To the last statement no exception can be taken. No human task is performed "as efficiently as it might be." But that none of the functions of the teacher is efficiently performed is a dogmatic statement of the kind which the maker of the statement deprecates, of the kind which he attributes to the opponents of scientific management in education: "statements of opinions unsupported by data of experience or investigation, unsupported even by argument," unless indeed the question is begged by the use of the words "efficiently performed." If "efficiently" means according to the principles of scientific management and with the aims of that system in view, the statement is correct. If efficiently means—but what is the meaning of efficiency? Those who would apply the principles of scientific management to education nowhere define the word, nowhere tell how efficiency can be measured. A "scientific" system based upon "scientific" data is to be applied to educational reform without explanation or definition of the most fundamental datum of that system. Oh, *varium et mutabile semper—scientia!*

Granting that the work of the teacher is not being done as well as it might be, or should be, is the reason therefore that he has too varied duties to perform? The trouble would seem to be not the diversity of functions but rather to onerous duties; not too *many* functions but too *much*. The advocates of

scientific management in education say that it is these administrative "duties which shut the instructors off from personal contact with students; which makes [*sic*] the contact they seem to have unreal and gives them a false view of students."

No proof of this statement is offered. It is simply the opinion of the author quoted, who advances this opinion as an argument for the introduction of scientific management in the college. He further says: "An instructor who does *nothing but teach*,[1] but has *leisure* for informal intercourse with students, can learn to know the student as he really is, and by the power that knowledge gives him can 'reach' the student and inspire him in the classroom."

Let us analyze this statement. Is it because an instructor "does nothing but teach" that he is enabled "to know the student as he really is," or is it because he "has leisure for informal intercourse with students" that he is able to understand, to "reach" and to inspire them? The argument is in fact as follows: The teacher should have leisure. He should use this leisure for informal intercourse with students. Informal intercourse with students gives knowledge of what the student really is. Knowledge of what the student really is furnishes power to reach and inspire the student.

Whether the instructor "does nothing but teach" has no bearing upon the case. He may do nothing but teach and be teaching so continuously that he has no opportunity for informal intercourse. He may do nothing but teach and become so narrowly specialized, so limited in outlook, so atrophied in character as to be helpless to the student and hopeless for himself. Not functionalization but diversity and leisure is the great need in education; not delimitation of the teacher's powers but opportunity to employ them. But again the crux obtrudes itself: the *cost* of leisure and opportunity.

Another dictum of the advocate of scientific management in education is that "it is a principle of scientific management that the determination of *how* be entrusted to specialists and

[1] The italics are the present writer's.

not left to the workman, thereby eliminating the waste of misapplied effort."

Two things he has forgotten. First: he is trying to prove the applicability of the principles of scientific management to educational institutions.

His argument is as follows:

Theorem: to prove that the principles of scientific management are applicable to, and should be applied to the educational institution.

Proof: The principles of scientific management have proved efficacious in many industrial institutions. It is *my opinion* that if these principles were applied to the educational institution certain beneficial results would follow. These results are desired and striven for by educators. Therefore, the principles of scientific management are applicable to, and should be applied to the educational institution. Q. E. D.!

Second: The counsel for—one feels tempted to say the *offence*—has forgotten that in teaching, as in many other professions and trades, the workman is the specialist to whom must be left "the determination of how."

Would the scientific manager, it may be asked, select a group of art critics, specialists, to determine the "how" for painters and sculptors? Yet the canvas and pigments, the clay and the stone are infinitely simple things as compared with the human mind with which the educator deals. Functional organization, doubtless, would produce pictures of a kind; and functional organization, doubtless, would produce education—of a kind.

But the end is not yet. "To apply one principle [of scientific management] makes necessary application of all the others [we shall return to this later], for the body of principles of scientific management is an organic whole; . . . . Functional organization involves wise selection of men (instructors, advisors, disciplinarians, etc.), wise selection of equipment (pedagogical methods and apparatus) [with the implication that unfunctional organization does not involve such wise selection, or is incapable of it], and wise classifica-

tion of *material* (*students;* according to scholarship, natural ability, preparation, health, temperament, etc.). [The present writer's italicization of words which will be especially considered later.] It requires these wise selections and, what is more significant, *it, and it alone, makes these selections possible.*"[1]

We may pause a moment to observe that modesty does not appear to be one of the principles of scientific management.

If we consider the criticisms of this paragraph in the inverse order of their enumeration above, we may seek first "the determination of how" functional organization and it alone has the power of making wise selections of men and things. We are not told. The human body is a highly functionalized organization and its functional members, selected through millions of years of evolution, depend for wise selection of their activities upon the brain, the mind, the soul, if you will. What is the selective evolution in scientific management? What is its selective mind, what is its soul? Scientific management is a "business proposition," and its soul is greater gain and less cost; a perfectly legitimate spirit in business enterprise, but a spirit whose rule in educational affairs is to be deplored and combatted.

In the next place, the author quoted speaks of students as "material," raw material, to be classified. The present writer refuses to accept this definition of the raw material of the educational factory, and in another place he has endeavored to show that the student is really a workman. But calling the student raw material for the sake of argument, let us follow the scientific manager farther. He says: "An immediate, tangible, practical reward for efficiency is unquestionably a powerful force. Is it not possible that something more could be made of this principle by educators? The reward of being permitted to play on a foot-ball team, provided he is not below a certain rank in scholarship, has inspired many an athlete to better scholarship than he would otherwise have shown."

What a galaxy of glittering rewards is opened up by this

[1] The present writer's italics.

sentence! It used to be thought that education, like virtue, was its own reward, and that knowledge, wisdom and learning should be diligently pursued for their own sake. Under scientific management they are to be pursued for the sake of athletic honors. If we might paraphrase some once famous verses we should say,

> One French verb for the relay team;
> Two Latin verbs for the base-ball team;
> The whole Greek grammar for the foot-ball team.
> So study, boys, study with care,
> In the presence of the functional managaire.

But let us return to prose and earth, and ask by what principle of scientific management "rewards" are offered to the "raw material" of a factory as bonus for "efficiency" of that raw material! To the historic inquiry "what is truth?" we may in bewilderment add the inquiry, what is science? And may say, if this be science give us—common sense.

Finally, the scientific manager of the educational institution has said that it is necessary to apply *all* of the principles of scientific management, but nowhere, except in the case of the raw material mentioned above, does he make a suggestion of a bonus to the workman, the teacher, for efficiency. Possibly, knowing the kind of workman with whom he is dealing, he is assured that none would ever reach an efficiency—undefined, it will be remembered—an efficiency high enough to earn a bonus; or perhaps the workman's reward is indicated in the following paragraph: "The teacher who is relieved of the burden of too many functions would find himself freer to investigate widely, think deeply, know life and form individual judgments. . . . The erect figure, the keen eye, the intense earnestness, the precise statement of fact and principle, the wise choice of interesting and illuminating illustrations, characteristics which, in addition to scholarship, make the great teacher, would continue to exist and to arouse and inspire." We may well end here, lest by further functionalized management there be taken from the teacher "even that which he hath."